SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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SALVAGING SUBMERGED TREASURES WITH DEEP-SEA SUIT AND SUBMARINE CUTTING TORCH.—[See page 163]

Scientific American Publishing Co., Munn & Co., New York

For 16 *Years* INTERNATIONAL *Motor Trucks* Have Made Transportation History

WHILE others have come and disappeared again, International Motor Trucks have advanced steadily to a position among the few leaders in truck sales. Year after year their sound reputation has been passed on from old to new owners. Their popularity is conceded by users. Fleet orders and repeat orders, based on dependability, utility, and low operating cost, are forcing production to new records.

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This Company is fortunate in the possession of a unique field organization, capped by 93 branch houses strategically located in principal cities. These have been functioning for years in the interests of the Company's varied activities. Each maintains a completely equipped motor truck service station, in charge of highly trained specialists and road engineers whose single purpose is to safeguard the performance of International Motor Trucks.

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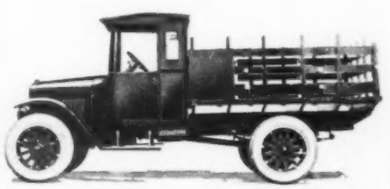
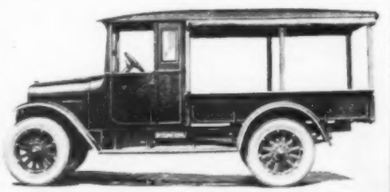
Model S International Speed Truck with open express body and enclosed cab. Three-quarter or semi-enclosed cab can be supplied.



Panel stake body with three-quarter enclosed cab. Enclosed or semi-enclosed cab can be supplied with this type of body.



Open express body with full length top and three-quarter enclosed cab. Enclosed cab and side and rear screens available if desired.

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CHICAGO OF AMERICA (INCORPORATED) USA

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This performance was obtained during the race of October 22nd for the Ohio River Championship, won by the "Miss Cincinnati" which covered 25 miles in 29 minutes and 8 seconds, including the time lost in making the turns at the ends of the 5-mile course.

Such performance is not unusual for **SKF** marked ball bearings—which are daily demonstrating their remarkable stamina and dependability in marine, aeronautical, automotive and industrial equipment of all kinds.

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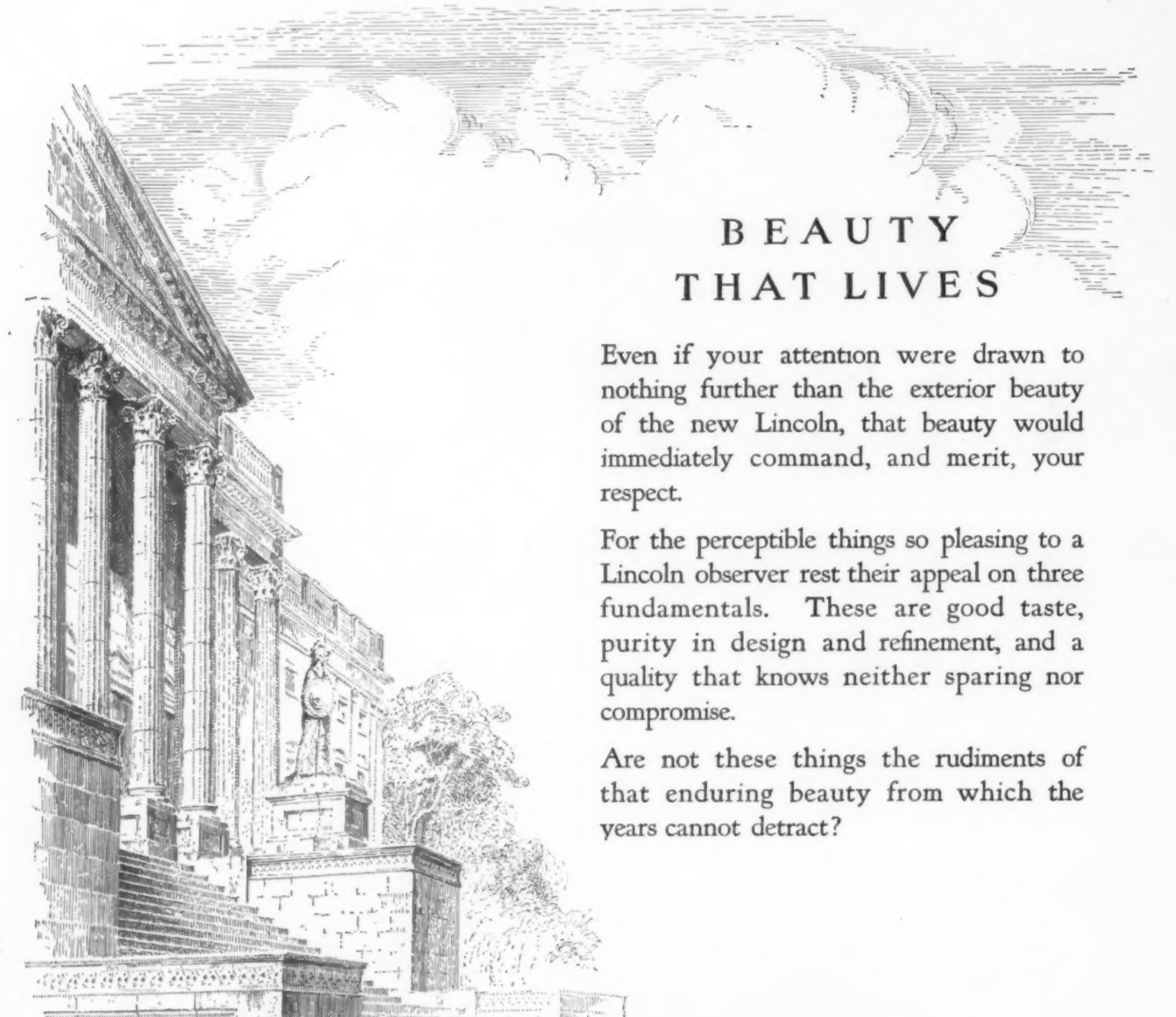

BEAUTY THAT LIVES

Even if your attention were drawn to nothing further than the exterior beauty of the new Lincoln, that beauty would immediately command, and merit, your respect.

For the perceptible things so pleasing to a Lincoln observer rest their appeal on three fundamentals. These are good taste, purity in design and refinement, and a quality that knows neither sparing nor compromise.

Are not these things the rudiments of that enduring beauty from which the years cannot detract?

LINCOLN

With the Editors

IN OUR regular mail there recently came a letter from Krupps of Essen. The letter, which was a lengthy one, stated in brief that the SCIENTIFIC AMERICAN was regularly read by the officials and the various department heads of that huge manufacturing firm, and held in the highest esteem. But in a quite recent issue we had made a statement which caused the Krupps concern. It appears that in an editorial we stated as a fact that the super-range guns built by the Krupp arsenal and employed by the German army for the long-range bombardment of Paris during the fateful days of 1918, had never been located by the Allied Control Commission and it appeared very much as though those great guns were cached in some out-of-the-way corner of Germany, ready to be brought out and set up for a future conflict. Well, the Krupps have taken exception to that statement and to our doubts as to Germany's good faith in the path of peace. Herr Bauer of the great Krupp establishment tells us that six super-range guns were produced and that three of these were employed in the bombardment of Paris. Following the Armistice and the disarming of Germany, the six guns were converted into articles of peace. The letter will be published in full in a forthcoming issue, for it is interesting reading. Meanwhile, we are pleased to learn that the Krupps, in far-off Essen, read the SCIENTIFIC AMERICAN so diligently despite the thrilling events through which they are now passing.

THAT infallible barometer in magazine editing—the correspondence basket—indicates that the Smith articles on safe-breaking and check forgery have met with the fullest possible approval on the part of our circle of readers. It was only necessary for Mr. Smith to point out in his check article that those little slips of paper which we handle in everyday life in lieu of currency were easy prey for scheming criminals, to open the flood-gates of the inventive talent which resides in almost all of us. Letters have been pouring in to the editorial rooms, complimenting Mr. Smith on the one hand, and pointing out remedies for the check raising and check forgery situation on the other. Many of the suggestions are really ingenious and indicate a true understanding of the nature of the problem from the angle of the check user and the banker. Many are, of course, too elaborate and would involve so much time and trouble on the part of all concerned as to slow up our present check habit. Many are not sufficiently proof against the ingenious check raisers to warrant their introduction. Then, too, we have received numerous kinds of so-called safety inks which are claimed to be erasure and acid proof. All in all, it has been a most pleasing reponse.

ENCOURAGED by such a reception, we have arranged with Mr. Smith for further articles on the constant battle between the criminal and the law. In an early issue there will appear a fascinating account of the development and growth of alarm systems of all kinds, ranging from the elaborate wiring schemes whereby the premises to be protected is surrounded with a mesh of wires carrying an electric current which, if interrupted or disturbed in any way, flashes a warning to a central police station, to the home-made alarms in which a shotgun is made to discharge its lethal load upon the opening of a door.

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AND while dealing with articles on criminology, it is opportune to state that we shall soon publish an interesting account of bombs and bomb-makers. The making of bombs, it seems, is an imported art. In certain countries of Europe where feuds are constantly waged, bomb-making is taught with quite the same thoroughness as the more genteel arts of everyday life. And while our American ideals may not find room for the bomb-maker and his art, the fact remains that the bomb-maker is nevertheless in our midst and occasionally gives us ample evidence to that effect. It has remained for Mr. Roy Giles, an occasional writer for our columns and a close student of the underworld, to prepare an article on bombs and their authors. As might well be expected, we could find few suitable illustrations for such a story, for the simple reason that successful bombs come before the public only after they have been neatly divided into tens of thousands of pieces of matter flung to the four winds. However, with the aid of Lieut. Gegan, the well-known bomb expert of the New York Police, and C. J. Robb of the Burns Detective Agency, Mr. Giles has reconstructed the Wall Street bomb which took a heavy toll of life, and the famous Los Angeles *Times* bomb. Photographs have been made of these reconstructed bombs, but, lest we be accused of conducting a popular course in bomb-making, Messrs. Gegan, Robb and Giles have purposely omitted certain delicate details of the bombs while presenting a true picture of the general layout.

THE representatives of the New York *World* and those of the well-known French inventor, Edouard Belin, were getting together on the final details of a contract, whereby the *World* would receive full rights to the Belin system for the transmission of photographs and drawings by wire and by radio in the United States. Suddenly the question came up, as it must come up in an agreement of this kind, as to what would constitute satisfactory performance of the Belin system. It was agreed that the performance would have to equal that attained regularly in France by a leading Parisian newspaper. But who would serve as a judge of performance in case of a disagreement? The *World* representatives suggested the editorial staff of the SCIENTIFIC AMERICAN. The Belin representatives immediately accepted. And we became the arbiters in this matter if there should be any question of performance. Once more we are pleased to contribute a helping hand to a worthy invention and thus help make, as well as chronicle, scientific history.

AND still we must talk about ourselves. We have received a request from the Scripps newspaper syndicate for permission to reproduce our naval editorials, for which our journal has long been admired in and out of naval circles. It is with real pleasure that we have granted permission for the wider circulation of our thoughts. Editorials, after all, transcend all other forms of writing. They may attack men and methods and things on the one hand, while suggesting improvements and ways and means of bettering conditions on the other. They are a true expression of the editorial mind. They must extend beyond the confines of any given publication, for they must be entirely unselfish to serve their true purpose. Hence if our editorial voice can at any time be broadcasted to a larger and still larger audience through the medium of quotation in other journals, so much the better.

Cincinnati Division

The territory served by the Cincinnati Division includes Southern Ohio, Northeastern Kentucky and Southeastern Indiana.

Detroit Division

The territory served by the Detroit Division includes Michigan, Northern Ohio and points in Northern Indiana.

6% of $3,500,000,000 Wasted Annually

THE Forest Products Industrial Research Laboratory, maintained by the United States Department of Agriculture in co-operation with the University of Wisconsin, estimates the partial annual loss to industry due to the use of poor or improperly designed shipping containers at $173,500,000.

In 1920 the railroads alone paid $108,000,000 in loss and damage claims. Many millions more were paid by them in repairing shipments received in poor condition. The expense involved in settling loss and damage claims is large.

The direct loss to shippers probably is greater than that mentioned above. It exists in the use of heavier than necessary containers; in the purchase of more lumber than is necessary; in the cost of assembling boxes; in added overhead expense; in impaired goodwill and in various other ways.

The total loss cannot be estimated accurately but authorities acknowledge it amounts to hundreds of millions of dollars yearly.

* * * *

The development of the General Box Company is a natural result of this wasteful economic condition. It is a consolidation of leading box manufacturers organized to provide a constructive boxing and crating service to all shippers east of the Rocky Mountains.

Briefly, this service is divided into four parts, as follows:

Engineering Service. G. B. C. box engineers are familiar with the most advanced principles of scientific box and crate construction as applied to the safe shipping of practically every commodity. Their services are available to any shipper without cost or obligation.

Raw materials. Raw material resources insure an adequate supply of lumber of uniform quality, suitable for boxing and crating purposes.

Production. Seventeen well equipped factories give ample facilities for producing wood boxes or crates in any quantities in the quickest possible time. Standardized manufacturing methods enable us to produce boxes of dependable quality at uniform prices.

Deliveries. Prompt deliveries are assured. If transportation difficulties make it impossible to ship from one plant we can from another. Only in event of a national calamity can our delivery service be impaired to any serious extent.

* * * *

The experience of the Locke Insulator Corporation illustrates what can be accomplished by scientific boxing and crating methods.

Locke had given serious consideration to their packing problems and had developed a very effective method of inside packing for their insulators. However, they were not satisfied with the kind of crate they were using. A G. B. C. box engineer was called in.

After thorough analysis the Pioneer (Wirebound) Crate, shown above, was recommended and adopted. On a trial shipment of several thousand of these crates to foreign countries not one insulator was damaged.

Continued use developed the following facts: Damage claims became negligible. Customers expressed approval. Freight and express charges were reduced — the new crate was 50% lighter than the old one. The cost of assembling was lowered. And 25% more crates could be shipped in the same space. The total savings amounted to many thousands of dollars.

This instance is typical of what can be done for shippers by competent box counsel — the natural result of specialized knowledge applied to a particular problem.

* * * *

We will be glad to send G. B. C. Service—a bulletin of information on better boxing and crating—to any one interested in this subject.

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Houston, Tex.
Illmo, Mo.
Kansas City, Mo.
Louisville, Ky.
Nashville, Tenn.
New Orleans, La.
Pearl River, La.
Sheboygan, Wis.
Winchendon, Mass.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MARCH, 1923

Where the Workman's Wages Go

THE American workman, as everybody knows, is getting a lot more money than he used to get. As everybody knows, he needs it. A question of frequent dispute is whether his pay envelope has fattened in direct proportion to the increase to be observed in the price-ticket attached to his average purchase. But even if this question were answered finally, in the affirmative or in the negative, that would tell us merely how badly the American worker needs his fatter pay envelope; it would throw no light upon the more interesting question of what he does with the envelope's contents.

Now, of course, we all know individual workmen who offer up 60 or 80 per cent of their weekly wage, through the kind high priest of the bootleggers, to the God Bacchus. At the same time we all know individual wage-earners who turn as far from normalcy in the opposite direction, devoting absurd proportions of their incomes to the savings account, or to education of their children, or to the family's clothes, or to some other worthy cause. The question, "What does the worker do with his wages?" is not answered by citation of one or all of these abnormal cases. Nevertheless, it is not answered in complete accuracy unless all these abnormal cases are considered, with due weight given each.

It's a mighty question, what the grand average, generally representative, American worker does with it after he gets it. And, we hasten to reassure the reader, nobody has attempted to answer quite so large a question as this. But there exists the American Construction Council, with headquarters in Washington, whose function is to find out all there is to know about what makes building so high, and what would make it cheaper. In pursuance of its program of learning the facts about the construction industry, from top to bottom, the Council has interested itself in the ultimate end of the wages—excessive if you insist, but that is not the aim of the inquiry—that are paid to the sum total of the workers in this industry.

The Council is now in a position to make a preliminary report, based upon a large number of carefully verified individual returns. It is found that wages in the construction industry throughout the United States aggregate five billion dollars per year. Of this, $1,598,500,000 is spent for food, $766,500,000 for rent, and $663,000,000 for clothing. These figures are 32.0, 15.3, and 13.3 per cent, respectively, of the total. When we were first exposed to the technical terms of economics, it was impressed upon us that the fundamental wants of the human animal were for food, clothing and shelter. If this be true, the members of the race who are left in possession of 40 per cent of their resources after meeting these needs are rather more fortunate, perhaps, than they had realized; and comparison with the day when it took about 101 per cent of the working man's income to meet the outgo under these three heads might present an illuminating contrast.

In every classification we meet the big question mark of the miscellaneous item; and in the present classification it is the first thing we meet when we seek to learn the ultimate end of the 40 per cent of his wage over which the worker has, himself, major control. No less than $601,000,000 of the wage account of the construction worker is untabbed save by the negative assurance that it went for none of the things specifically listed. Much of this "miscellaneous" expenditure could doubtless be put under the head of recreation, if better classification were demanded. But carfare, income taxes, funeral expenses, the cost of buying and running a car that is used for something other than pure pastime, the expense of giving the children a better education than the parents had; these and other unclassified items are found in every family and, by the end of the year, have mounted up to an amazing total. That they constitute 12 per cent of the wage-earner's budget is, after all, not surprising.

Another 12 per cent, which is listed this time as an even $600,000,000, goes into the savings fund. This, of course, includes, today, the purchase of Liberty bonds, of employee's stock in the employing company, and of stocks and bonds bought in the open market, as well as the mere savings bank and building loan accounts to which the workman with the frugal disposition largely confined himself in the pre-war days.

The really large expense items are now exhausted, and when we list expenditures for recreation we find that the total drops to $229,500,000, and the percentage to 4.6. This is certainly low, and affords more ground than ever for supposing that much that should be here is concealed in the miscellaneous account.

Fuel and light bills foot up to $214,500,000, or 4.3 per cent of the total income; but this item is highly deceptive by virtue of the fact that every family that pays rent to a landlord covers some of its heating and lighting expense in this fashion.

Another drop in magnitude comes with the next item of expense: $126,000,000 for furniture, furnishings and general supplies—2.5 per cent of the payroll. The doctor gets almost as much as this: $113,000,000, or 2.3 per cent—though, of course, he has to share this with the dentist and the druggist. Finally, at the bottom of the list, come church and charity with $46,500,000, and reading matter with $41,500,000—0.9 and 0.8 per cent, respectively. We were tempted to remark that the building worker's charity evidently begins at home; but candor compels the admission that we, personally, are behind him in our support of religion and benevolence. As a matter of fact, here is one case of a misrepresentative average. Nobody, we believe, gives 1 per cent of his income to church and charity; some give much more, the rest little or nothing.

Here we have the smaller items of expenditure by the typical American wage earner; his major expenses are diagrammed below

The areas of the several circles in the two groups above in which the different items are pictured are proportional to the amount spent in the directions indicated. The figures have been compiled from the construction industry alone, and are believed to be thoroughly representative of this industry. There seems no reason to suppose that, as a whole, those who earn their money here spend it differently from those who earn it elsewhere; and the construction industry is large enough to permit its personnel to stand as representative of all American wage earners

What the American wage earner does with his wages, told in graphic form

Bas-relief of a goat from Lisht

Digging Back Three Thousand Years

Recent Discoveries that Throw Much New Light Upon Early Egypt

By Albert A. Hopkins

PERSISTENCE usually brings its reward. For nearly sixteen years Lord Carnarvon and Mr. Howard Carter have been engaged in somewhat tedious excavations in part of the site of ancient Thebes, on the west bank of the Nile at Luxor. They had the usual run of luck to which archaeologists become accustomed. Some seasons proved productive, others were sterile of results. But toward the end of November the whole world was electrified by the news that a discovery had been made which threw all former explorations into the background, and which seemed destined to give us an entirely new or, at least, a much better understanding of Egyptian art and culture.

We are fortunate in being able to reproduce the one authentic picture which has up to the time of writing come through. We are indebted for it to the enterprise of *The Illustrated London News*, who dispatched their special artist, Mr. A. Forestier, to intercept and interview Lord Carnarvon at Marseilles as he was on the way home. It shows the first inspection of the outer chamber of King Tutankhamen's tomb. "By the uncertain light of a candle a wonderful sight was exposed to our excited eyes. . . . The first thing that one noticed against the wall facing the door were three gigantic carved gilt wood beds, the ends of the beds having carved heads. Beneath the central couch were heaped twenty or thirty white wood boxes containing mummified legs of mutton, ducks, geese, venison, and the like. . . . Beneath another bed was the throne of the king. . . . We found four chariot bodies in gilt wood inlaid with semi-precious stones. At the northern end are two life-sized portrait statues of the king in bituminized wood. On one brow is the crown of Egypt; around his neck is the gilt collar, emblem of royalty; he is clad in the 'Shenti,' a sort of stiff kilt. In one hand he holds a long gilt stick; in the other a gilt mace. . . . Between the two statues we found a walled and plastered-up entrance. In all probability behind that wall we shall come to the funerary chamber of King Tutankhamen." So Lord Carnarvon describes the great find.

Some general information in relation to the position of the tomb and the chronological place of the king may be in order. The royal tombs of the new kingdom, period XVIII.-XX. dynasties, cover the years from 1580 to 1202 B. C. They are all in a valley, sunk in a plateau 1300 feet above sea level. The name of the location is the Valley of the Tombs of the Kings, and the scenery is most austere. Vegetation is absent, for rain is unknown in Upper Egypt; and of course the overflow of the Nile fertilizes only the lowlands. Near by are the Tombs of the Queens and the Ramesseum and the Temple of Medinet Habu. Nearest of all, and separated by lofty cliffs are the ruins of Deir el Bahri, being excavated by the Metropolitan Museum of Art and which we shall describe later in this article. Across the Nile are the temples of Luxor and Karnak. Certainly this is a wonderful locality for archaeological research. Thebes was a great capital 3500 years ago. Babylon existed, it is true, but Athens and Rome were not as yet founded. Sixty-one tombs have been discovered hidden away in the wonderful valley. Some of them are 1000 feet long. One royal mummy has been left in its own tomb and this is lighted by electricity. The Egyptian government very unwisely moves these royal mummies to Cairo where the dampness causes rapid disintegration.

Many of the newspaper accounts are inaccurate, and most of the pictures supplied are spurious. Flashlights were taken, but they were worthless. The chamber is now being wired for electric lights so that the objects can be photographed *in situ*. All this requires time. The attitude of the Egyptian authorities may result in additional delay. They do not seem to be satisfied with their half and want to claim the entire find. It would be no more than an archaeological crime to entomb all the objects in the Cairo Museum, for so few people ever get to Egypt owing to the great expense and the time involved.

A word of caution may be inserted about the value of the finds. It has been variously stated that they are worth from $4,000,000 to $30,000,000. Now, as a matter of fact, Sir Joseph Duveen, a most competent authority, inclines to the former figure but wisely says this estimate is based on insufficient knowledge. Egyptian art is not especially collected by amateurs and most of the objects naturally gravitate to museums and they are notoriously hard-pressed for funds, so that this must be considered in any estimate of commercial values.

A few items of interest relative to the find seem authentic and are therefore worthy of mention. Actual perfumes have been found in alabaster vases; therefore we are able to tell what scents were used on the body of the Pharaoh. Some of the finds prove conclusively that the kings wore linen underwear and had artificial lights. Prof. Flinders Petrie considers that the real reason for the collection of furniture, clothing, etc., in Tutankhamen's tomb was that the royal family came to an end at this point, leaving no heirs. So they placed in the tomb all the best palace furniture. It was not the ordinary funeral furniture which would be buried, as usual, with a king, but a general clearance of the contents of the palace because there was no immediate heir.

Those who have made this great find are not the only workers in the Egyptian field. In our issue for April, 1922, we described the Egyptian expedition of the Metropolitan Museum of Art for 1920-1921, and we can now recount the successes of 1921-1922, when broad programs of investigation were carried out upon the American concessions at the Pyramids of Lisht and in the Theban Necropolis. Its parallel pieces of excavation on these two sites began in early December and extended into the following May with an average force of 350 workmen on each site. Mr. Mace's excavations at Lisht were centered on the clearing of the northern pyramid and the tombs adjacent to it. The finds are important but most interesting of all is the chronicle of finding a plunderer's tunnel leading straight to a sarcophagus without touching the burial chamber at all. "Clearly," says Mr. Mace, "it was the work of men who knew the exact lay-out of the chambers, and it is more than probable that it was planned and excavated by the foreman in charge of the tomb-construction. The robbery in this case took place within a very few days of the funeral. The tunnel was ready. The robbers had but to break through the bottom of the coffin itself and the treasure was in their hands. So much for the contemporary plunderer and his pleasant little ways."

We must now pass to Thebes where the Museum's expedition was so fortunate as to discover the models of Mehenkwerte already illustrated and described in the SCIENTIFIC AMERICAN for May 7, 1921, and the tomb of Queen Aashaït and the little Princess Maït, described in our issue for April, 1922. The excavations at Deir El Bahri are very near the location of the wonderful discoveries described in the beginning of this article. The temple of Mentuhotep III was built under a towering cliff and had previously been cleared in part between 1903 and 1907, but the object of the Metropolitan Expedition was to clear the southern half of the court. In front of the courtyard they dug parallel trenches to bed rock. In the latter the men began to strike the mouths of enormous circular pits, 30 feet deep. These were found to be tree holes arranged in symmetrical order as shown in our photograph. No landscape architect could do better today. The holes were filled with soil and tree roots. Other holes were found which were filled up owing to some change in plan. An oasis of green was provided to relieve the rugged bareness of the desert cliffs. The architect's plan for the grove has even been found, but the actual project was altered after making it. Black soil was filled into the great holes, sufficiently lightened with river sand. In this earth, lying horizontally and quite close together about five or six inches below the surface, the explorers noticed round poles three inches in diameter and six feet long. These poles were readily identified as sycamore fig branches, but their presence there was very puzzling until one of them was cleared of the surrounding mud. The miraculous dryness of the Egyptian desert had preserved the explanation for 4000 years and they were able to photograph shoots and roots sprouting from every knot. In other words, these poles were nothing more nor less than a gardener's cuttings of unusual size and crowded close together to give quick results, and a thick clump of green. For a short time they were a great success,

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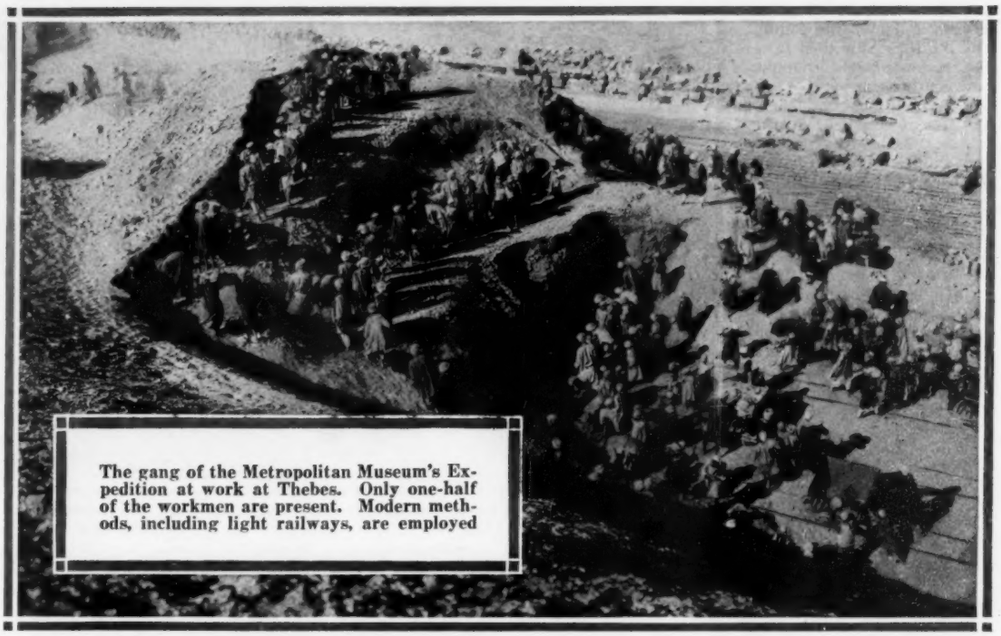
Howard Carter making the first inspection of the great Egyptian treasure in the outer chamber of Tutankhamen's tomb at Thebes

and then the caretakers of the temple had neglected to water them; the young trees had parched and dried, and the axe marks of the wood choppers still showed how they had been cleared away.

The cornerstone deposit was found; and one of the careless old priests had stepped on a wet brick which had just been laid with ceremony at the cornerstone, and his footprint tells the tale. "The reader must think of archaeology in Egypt," says Mr. Winlock, "as a rather ghoulish calling, and sometimes it must be hard to understand why there is so much that is connected with death and burial in every account of digging there. At least one-half of the answer is that the ancient Egyptian's tomb—his 'eternal house'—was one of his chief cares and it is only through it that we can see his earthly dwelling." The Metropolitan Expedition found many embalming articles and our knowledge of the processes has been increased thereby. Space will permit only of describing some letters on papyrus which are among the oldest in the world. These are known as the "Hekanakht Papers," and will prove in time to be among the great classical documents of their kind, picturing as they do Egyptian agricultural life of 4000 years ago. We may take them as being about the most intimate and naïve self-portrait that any Egyptian of the day has left us.



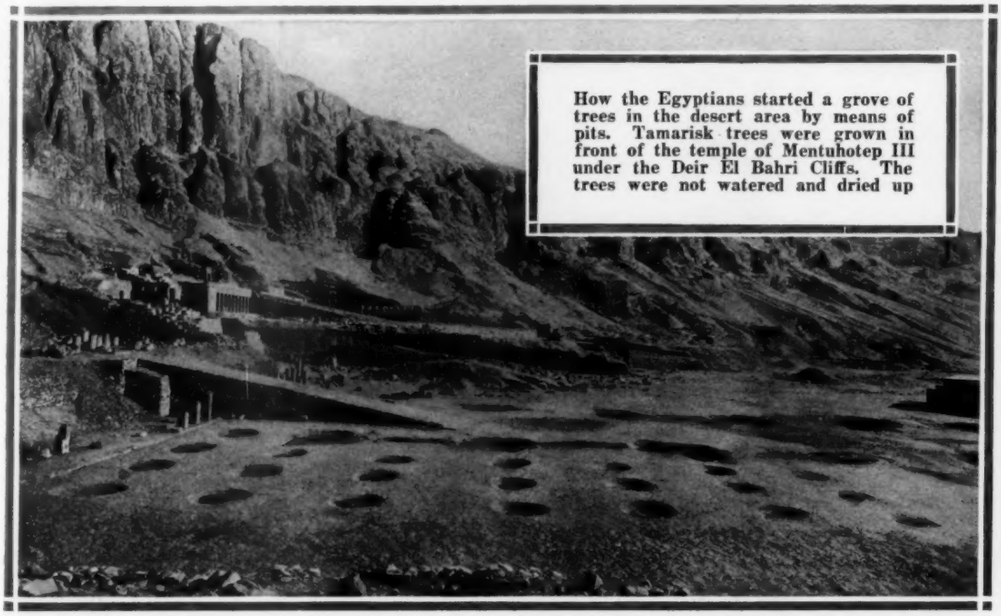
The gang of the Metropolitan Museum's Expedition at work at Thebes. Only one-half of the workmen are present. Modern methods, including light railways, are employed

Accounts are found, and there are letters of Hekanakht to his son, which are full of human interest. The old farmer-priest was rich but very "close," and had to make long journeys to look after his estates. Hekanakht was in the habit of going down to Memphis and leaving his eldest son in charge of the household in Nebesyt. Before the first of his trips of which we know, he calls in Mersu, two other grown sons, and his confidential man, Heti, son of Nakht, and spreading a large sheet of papyrus across his knee he begins to take stock of his affairs. He starts out: "5th Year of the Reign, 2d Month of Shômu, 9th Day." To Hekanakht, writing a date that way was as natural as writing "10/10/22" would be to us, but it was only from finding this account in the sealed tomb that we could guess that the reign of Mentuhotep III or, more likely, Mentuhotep V was meant. Until this was settled, "Shômu" signified little to us. In theory the Shômu was the harvest season between March 16 and July 13, but as the Egyptian calendar had no leap years the calendar's seasons came around one day earlier every fourth year, until in the reign of Mentuhotep V the Shômu had come in the autumn. For us, therefore the date would be October 10, 2004 B. C.

Below the date follow the heading, "Statement of Hekanakht's barley" and the sub-headings, "Made over by him to his son Mersu," "Fodder for the Bulls," and "The barley that Hekanakht has obtained for his dependents," all duly itemized with spelt (which was worth only two-thirds as much as barley) entered in red to prevent mistakes in addition. Next comes a "Statement of bulls that Hekanakht has made over to his son Sinebnut" with thirty-five head of cattle listed under five breeds, and a note: "But if Sinebnut appeals to me about any bull that is missing . . . half the loss shall be upon him and Heti son of Nakht." Evidently when the old fellow set his house in order every eventuality was provided for. Finally comes a "Statement of bread given to Mersu son of Hekanakht" of three different kinds giving a grand total of 7000 loaves. Seven thousand loaves of bread would have seemed to us an immoderately large baking if we had not been acquainted with Hekanakht's descendants of today. Many of them bake only every other month little biscuits that will keep indefinitely but that are so stony hard that they must be soaked in soup before the toughest jaws can crack them.

Let us hope that Mersu was faithful in his stewardship and that Sinebnut did not have to "appeal about any bull that was missing." In any case we do not know what befell the family on that first trip of old Hekanakht's. We have the account simply because Mersu preserved it and when his father was preparing for a second trip in the Eighth Year, the old scroll was brought out again and the economical old man found plenty of room to write out another inventory on it. This time he is leaving for Memphis in May or June. The crops have been harvested and 551¼ bushels of barley and spelt are left with Mersu or stored with some thirteen other people in the neighborhood, but it is still too early for the grain to have been milled and baked into loaves. The cattle are not listed on this sheet—but the letters refer to them—and there is added to the cares of the family a grove of trees from which timber is to be sold. When all was in order the old fellow set sail for Memphis and Dedisut.

Hekanakht's first letter was written just after he had returned from Dedisut to his other Memphite estates—"when I came hither southwards." It was still summer time, for he wanted Mersu to send "five bushels of wheat and what thou canst find in barley and also the surplus of your victuals until you get to the Shômu," which began on September 2. In fact he probably wrote it about the first of August, for the inundation was still not high enough to predict its eventual quality, and the letter contains instructions in case "it turns out to be a good Nile." The Nile, in fact, had just begun to rise and Mersu, in the midst of cultivating his summer crops, had written that he feared his dykes might not hold and that the waters might burst over his fields before he could reap them. The old man, too indignant to waste time on the greetings which were half the zest of letter writing to an Egyptian, dashes off his reply. He left his son at Thebes as manager, and was continually writing him about this or that. The son Mersu felt a little shaky as to the strength of the dykes and passed this on to his father. The peppery old man wasted no words in salutation, although they were usually as polite as Spaniards and wrote: "As to any flooding on our land, it is thou who art cultivating it. Woe to all my people with thee! I shall hold thee responsible for it. Be very active in cultivation, and be very careful. Guard the produce of my grain—guard everything of mine for I shall hold thee responsible for it. . . . You must give these victuals to my people only while they are doing work. Mind this! Make the most of all my land; strive to the uttermost; dig the ground with your noses in the work. See, if you are industrious, one will praise God for you. Lucky that I can support you."



How the Egyptians started a grove of trees in the desert area by means of pits. Tamarisk trees were grown in front of the temple of Mentuhotep III under the Deir El Bahri Cliffs. The trees were not watered and dried up

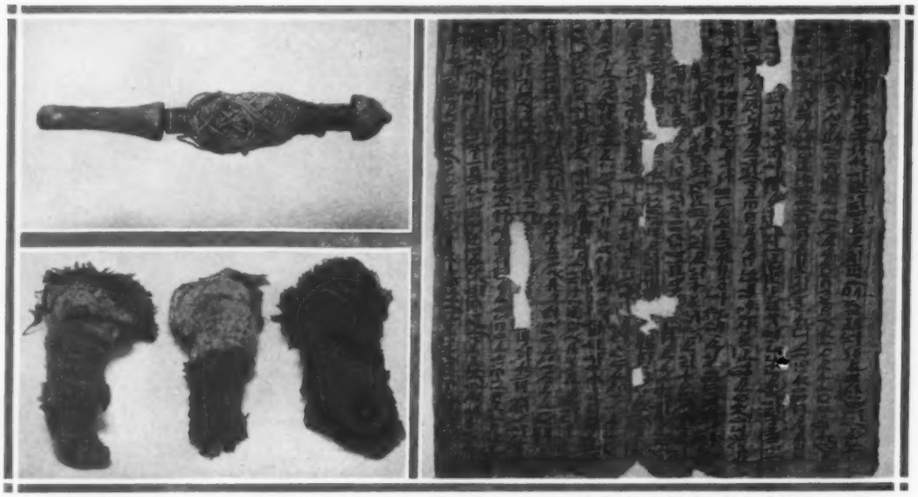
The Nile of a past winter had turned out to be so direfully low that the fields were parched, the crops had failed, and with last year's stores of food now exhausted, famine was stalking after the disastrous harvest. Old Hekanakht is in a different mood this time, and he does not forget to write those salutations with which a letter should begin:

"The son speaks to his mother; the Ka-servant Hekanakht to his mother Ipy, and to Hetepet: How are you in your life, safety, and health, by the blessings of the God Montu, Lord of Thebes?

"To the whole household: How are you? How are you in your life, safety, and health? Do not worry about me; I am alive and well.

"Behold, you are as one who eats until he sates hunger, until he shuts his eyes, while the entire land is dead with famine.

"I have come hither southwards, and I have obtained your victuals as well as possible. Is the Nile not very low? Well behold, we have obtained victuals in proportion to it. Be patient you who are named, for you see I have been able to support



A mason's cord and reel
Packages of false hair

The first page of Hekanakht's first letter to his household in Nebesyt

you up to to day." Then he inserts a list of the family and the share due each from the rations he is sending, and continues:

"Now you must not be angry about this. See the whole household as well as the children are dependent on me and everything is mine. 'Half-life is better than dying altogether,' and they say 'the hungry must hunger.' Why, they have begun to eat men and women here! There are none anywhere else to whom such victuals are given.

"You must keep yourself going until I reach you. I shall spend the Shômu here"—in other words, until the thirtieth of next December.

When time permitted, and it was to his interest this old skinflint was urbane enough as the following example shows:

"The Servant of the Estate, the Ka-servant Hekanakht says:

"'May thy condition be like that of one who lives a million times! May the God Harishaf, Lord of Heracleopolis, and all the gods that are, aid thee! May the God Ptah south of his Memphite Wall, gladden thy heart as one who lives long! May thy rewards be excellent from Harishaf, Lord of Heracleopolis!'"

However, the most appealing part of the letters of Hekanakht to those of us who are not of the land, are the glimpses we get into the life of his family.

The oldest son was named Mersu. As his father saw him he was perhaps a little stupid and sometimes complaining, but at least he was dependable, and Hekanakht looks to him to run the complicated affairs of the family and to keep the house in order. Sinebnut and the family's confidential man, Heti son of Nakht, are Mersu's main helpmates, but the third son, Sihathor, we meet with in a less attractive light. In the first letter he had made a suggestion to Mersu which scandalizes old Hekanakht: "As to sending Sihathor to me with old, dried up barley from Dedisut and not giving me the 50 bushels in new barley—by no means! But thou art happy eating the good barley. 'I am on land and the boat is well moored, but when thou puttest ashore thou doest everything wrong.' If thou shouldst have sent me old barley to do duty for new—but what am I saying? Much good it is!" In the second letter Mersu is told to watch Sihathor whenever he comes to the house.

The three older brothers and Heti are all married and have families of their own living in the household of Nebesyt, and there are besides women and children in Hekanakht's own harem who bring the number of mouths to be fed up to at least thirty.

There was Ipy, his mother, and her maid, and with his mother Hekanakht greets a poor relation called Hetepet who has with her a little son Mey. Whether Hetepet was interfering or whether she was a bore is not divulged. In any case she was far from popular with Mersu, and Hekanakht is constrained to write, "I have told you, 'do not keep a woman-friend of Hetepet's away from her, whether a relative of hers or an acquaintance of hers.' Take great care of her, and I hope you will prosper in all things accordingly — although to be sure thou dost not wish her with thee."

In addition to the three married sons there were two boys, Anûpu and Sneferu. Neither one was old enough to be put to work when Hekanakht went away in the Fifth Year and therefore they do not appear in a list of rations which he left at that time, but on his second trip to the North, three years later, they are always present in his mind. "Take great care of Anûpu and Sneferu," he writes, "whether thou livest with them or diest with them. Mind this!" To Anûpu, who was the elder of the two and who was already old enough to help Mersu and Sihathor with the summer crops that came so near being flooded, this parental attention by the older brother was a little too much. During the winter he complained to the old man, and Mersu is ordered to "give back to him any article of Anûpu's that thou hast, and whatever is missing compensate him for it. Do not make me write to thee about it again. I have already written to thee twice about it."

The youngest son, a spoiled brat, Sneferu, is really his father's favorite. He was still a mere boy and when his father went away no special allowance was given him, but later Hekanakht decides otherwise and writes to Mersu, "See, if Sneferu has no allowance in the house with thee, do not fail to write about it. I have been told that he is discontented. Take great care of him and give him victuals. And salute him from Khentekh a thousand times, a million times. Take great care of him and thou must send him off to me directly after thou hast cultivated." However, traveling with the crotchety old man hardly meets Sneferu's idea of a good time. He plainly refused to go and the next summer we find the old man rather plaintively writing, "And if Sneferu should should want to look after the bulls, then put him to look after them, for he doesn't want to be running up and down cultivating with thee nor does he want to come hither with me. Indeed whatever he wants thou must let him enjoy it." Poor Mersu!

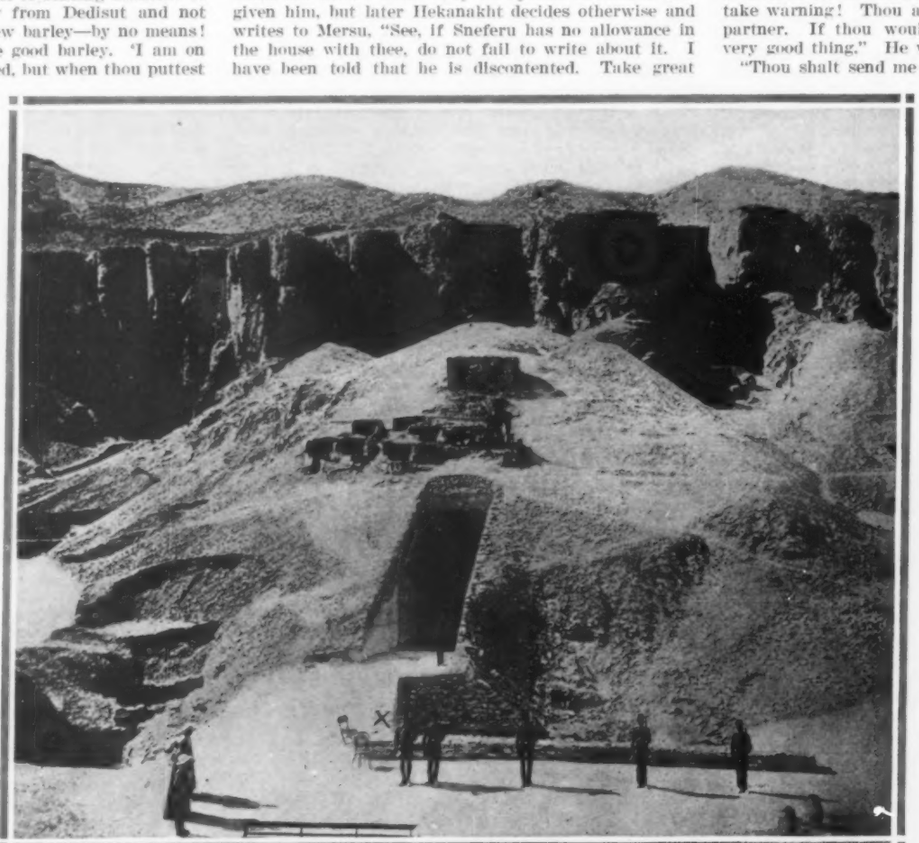
Evidently domestic life did not flow on very smoothly. Hekanakht was a widower so one would think that with a large household he would have had trouble enough. The East is unchangeable, however. No tirades of Hekanakht's could ever calm the troubled home waters, and the following summer the old man gives way and does what he should have done in the beginning. One would have thought that with that overgrown household of his he had troubles enough. Not at all, he must needs take a concubine to himself, named Iutenhab. The feelings of his family can be pictured clearly enough from the old fellow's irate messages to them:

"And have the housemaid Senen turned out of my house at once, and be very careful every day that Sihathor visits thee. Behold, if Senen spends a single day in the house, thou wilt be to blame if thou lettest her do harm to my concubine. What am I supporting thee for and what can my concubine do to you, you five boys?

"Salute my mother Ipy a thousand times, a million times, and salute Hetepet and the whole household and Nofret. And as to doing any harm to my concubine, take warning! Thou art not associated with me as a partner. If thou wouldst keep quiet it would be a very good thing." He writes:

"Thou shalt send me Iutenhab. As this man lives—I speak of our tenant Ip—he who shall interfere in any way with the concubine, he is against me and I am against him. Behold, this is my concubine and it is well known that a man's concubine ought to be treated well. See, there is not any one who would do for her the like of what I have done. Even if none of you would be patient should his wife be denounced to him, let me be patient. But how can I ever live with you in one establishment if you will not respect a concubine for my sake?"

We may be sure that nothing ever came of Hekanakht's insinuation that since Mersu is not a partner in his father's affairs he may be shown the door, or of his threats that he will turn all of his sons out of the establishment. Hekanakht relished far too much the opportunity of reminding them that they were "eating his bread" and that "everything was his and the whole household dependent on him." He was a fussy and hectoring old fellow whose letters were prodigally strewn with "Mind this": "Be very careful and be very active," and "I shall hold thee responsible for it." "Do not fail to answer about everything I have written.



Scene of the wonderful discovery in the Valley of the Kings. The tomb of Tutankhamen is shown by the cross

Gasoline Camels

An Endless-Belt Automobile for Crossing the Sandy Wastes of the Sahara

By Francis P. Mann

The Kegresse-Hinstin endless-belt automobile operating over snow. The front wheels in this case are provided with runners

THE camel is about to lose its occupation in the workaday world. As the picturesque "ship of the desert" it has survived all mechanical advances down through the ages. Until quite recently no man-made vehicle could compete with the camel in its native sandy element. But now that the automobile has been equipped with an ingenious and novel form of endless belt developed by French engineers, which has been tried out in a remarkable 2000-mile trip across the Sahara, it seems very much as though the camel is about to lose its monopoly.

Some time ago there was organized in France a tractor expedition which was to essay the crossing of the Sahara. The caravan consisted of five small endless-belt automobiles of the type shown in the accompanying illustrations, and was headed by four men, one of them representing the French government. The chauffeurs were chosen for competence as mechanics and also because of their powers of endurance, for the Sahara nights are as cold as the days are hot. The thermometer frequently drops 75 degrees within a few hours. The caravan was fully armed with rifles and machine guns to ward off possible attacks by desert tribesmen.

In 21 days this gasoline-driven caravan succeeded in crossing the Sahara desert from Tugurt in Algeria to Timbuctoo, a distance of 2000 miles, without a mishap. The same journey would require three months by camel caravan.

What is the gasoline camel? It is by no means an ordinary vehicle of the caterpillar type. It is an automobile with a novel form of endless belt drive of such construction as to permit the vehicle to travel over tracts of ground of the most irregular nature and without roads, over the snow, and in the very worst places, so that a new prospect will now be opened up to adventurous motorists.

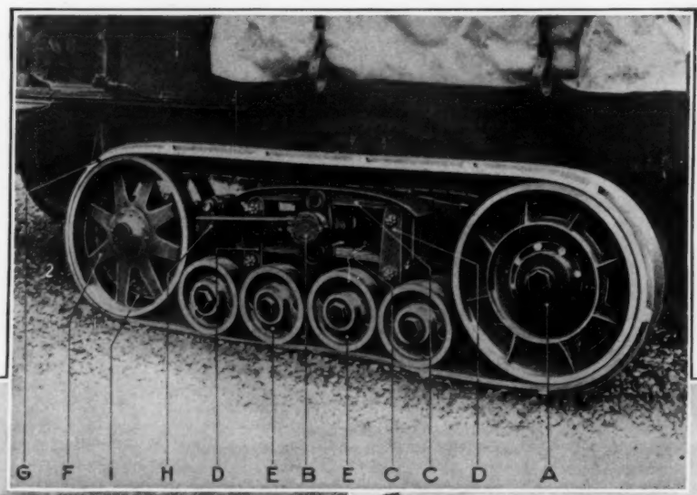
While the usual caterpillar system provided a good bearing surface upon the soil, the problem of travel was only partially solved, for there still remained the very important question of speed; in fact the caterpillar vehicle is unable to cover more than a few miles an hour. During the war, the tanks equipped with the caterpillar had to be brought to the spot upon heavy wheeled vehicles or by railroad, not only on account of their very slow travel, but also because the apparatus lacked the necessary solid construction, and would be rapidly put out of order by the shocks occasioned by travel over the roads.

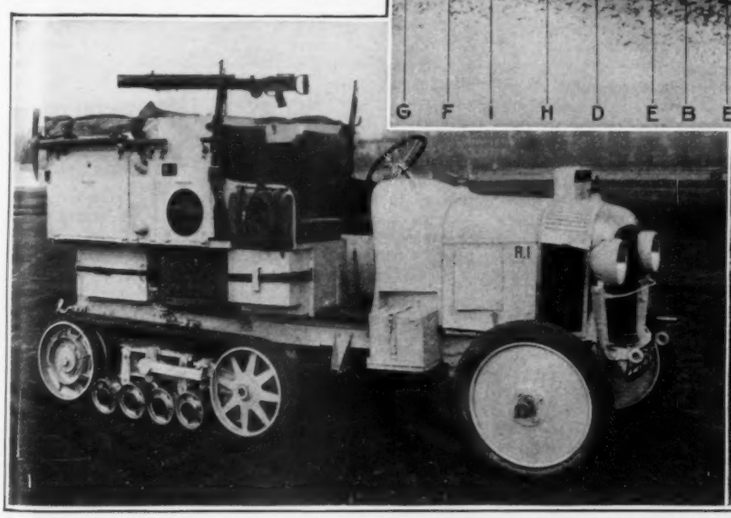
In view of the conditions which had to be met with, various inventors set to work in order to produce a combination vehicle which would fulfil the conditions of travel over soft ground and at the same time would make a good speed on the road as a practical touring car of moderate size. This difficult problem has now been solved in the new Kegresse-Hinstin vehicle, which is built at the well-known Citroën automobile works in Paris. In principle, the new car makes use of an endless belt of flexible nature which is ribbed on the outside and will wrap itself over the obstacle by means of an ingenious mechanical makeup of rollers, levers and spring, which, however, is of a substantial build and will stand very hard wear. The mechanical part is also made quite light, and as a whole the new car does not differ much from the usual touring vehicle in general appearance. A good spring mounting for the car is also obtained.

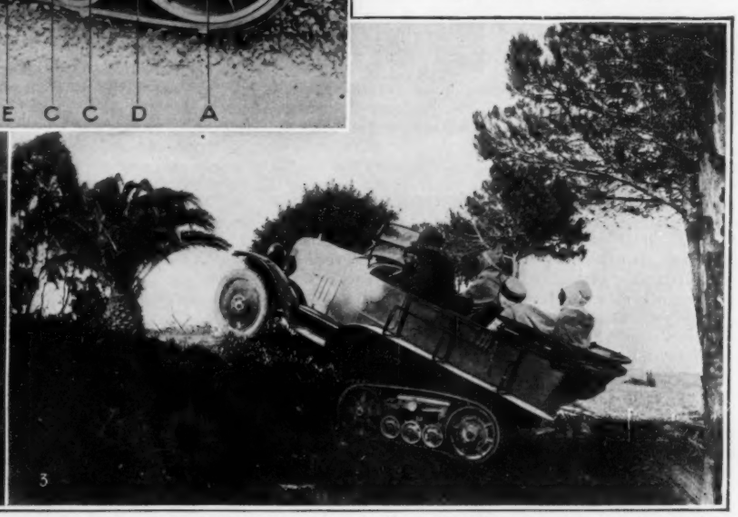
When traveling over an obstacle, a large stone for instance, the latter will raise the main front wheel which is mounted loose, and as the car moves forward each small roller (these being disposed in pairs) will take only one-eighth of the weight of the car upon the main vehicle axle, or eight times less than the weight upon a rubber-tired wheel, since at a given time the whole weight of the car will be brought to bear upon the stone. Another great advantage in the Kegresse apparatus is that the flexible belt is always worked at a light load and is ventilated upon all sides, so that it does not heat up to any appreciable extent. Its durability may be compared to that of an inflated tire which is used well below the top limit, but without any of the risks of puncturing. On the other hand, the new belt will keep up much better than a solid rubber tire.

Referring briefly to the general mechanism, it may be remarked that the endless-belt part of the apparatus is formed of rubber and cloth fabric of a suitable construction, the outer surface which works upon the ground having ribs whose design depends upon the use which is to be made of the vehicle, in order that this raised portion may properly catch upon the ground. The inside of the endless belt is given a special shape in order to work with the main wheels, these wheels being mounted in pairs with a space between them; the belt is smooth at the sides where it operates with the smooth pulleys, but at the middle part it has a rib which projects to some distance and fits into the space between the pulleys, the rib being split up into a certain number of teeth. This arrangement is found very useful for guiding the main belt and causing it to adhere to the pulleys, for in fact the wedge-shaped rib has a good fit between the wheels, and this also aids in the travel. As to the mechanism which is used with the endless belt

(Continued on page 207)







1: One of the "gasoline camels" employed in the Sahara exploration expedition which covered 2000 miles in 21 days. The expedition was armed with rifles and machine guns as a protection against possible attacks by belligerent tribesmen. 2: Near view of the endless-belt mechanism. The lettered parts are named and described in the text on page 211. 3: The endless-belt automobile operating over the most rugged kind of terrain. Note how the endless-belt member accommodates itself to the unevenness of the ground

Various phases of the endless-belt automobile which has been used in crossing the desert and which lends itself to adventurous motoring

Six Stages in One

The Remarkable Mechanism of a Current Production Which Permits of Startling Effects

THE outstanding novelty of the current theatrical year is undoubtedly the Selwyns' stupendous production of "Die Wunderlichen Geschichten des Kapellmeisters Kreisler," which opened at the Apollo Theater December 23 with the title "Johannes Kreisler," and Jacob Ben-Ami as its star. In Berlin, this fantastic melodrama by Carl Meinhard and Rudolf Bernauer, with its technical novelties invented by Svend Gade, was the reigning sensation for some 18 or 20 months. The story is based on the life and writings of E. T. A. Hoffman. The interpolative music, by E. N. von Resnicke, is a partial utilization of motifs from Hoffman's "Undine" and Mozart's "Don Juan." There are more than a hundred people in the cast, and the production is in 42 scenes. It will be offered in London at Drury Lane by Arthur Collins almost simultaneously with the American production by the Selwyns. Louis N. Parker has made the adaptation for both the English and the American stage. In New York the production has been made under the direction of Frank Reicher, the Selwyns' new producing director, and Svend Gade, the Danish inventor of the mechanical and lighting effects.

From the dramatic standpoint there have been many theatrical productions in New York equalling the interest of the Selwyns' presentation of "Johannes Kreisler," but in point of novelty it is unique and incomparable. Its 42 scenes pass before the eyes of the spectator in kaleidoscopic variety by the aid of a technical novelty invented by Svend Gade, and utilized for the first time with the German production of "Die Wunderlichen Geschichten des Kapellmeisters Kreisler." This novelty consists of an unique division of space on the stage and acceleration of changes which makes it possible to present 42 scenes within the usual time of the average theatrical production. In fact the production of the piece on the stage installed by Svend Gade at the "Theatre in Koeniggraetser Street" lasts—including two intermissions—exactly two and a half hours. During this time the 42 scenic changes take place. Of these 20 are in the first act, 12 in the second act, and 10 in the third. Since Lautenschlaeger of Munich, with his revolving stage, gave impetus to stage reform there has been a great deal of more or less successful experimentation in an effort to gain a quick and many sided changeability of stage pictures. This goal was never quite reached, however, until Mr. Gade accomplished his six stages in one for the presentation of the German version of "Johannes Kreisler."

The six-fold stage showing scenes at two levels as seen by the audience

To begin with, this stage was not created for its own sake. It was not until Mr. Meinhard and Mr. Bernauer had conceived the idea of presenting Hoffman's visions, and mental conflict, in dramatic form that the question of giving pictorial expression to his flights of thought and his emotions presented itself. Without this pictorial expression the production was out of the question, and it was equally certain that the problem could not be solved on the basis of existing stage mechanics. A new stage must be created, and Svend Gade (who is a Dane) accomplished it in a manner which has stirred the deepest interest of two continents. The innovations achieved by him embody both mechanical and lighting effects.

When the audience files into the theater and take their seats, they do not notice anything peculiar about the stage, except possibly the painted gauze which is bowed out from the proscenium arch, forming slight visual protection for what is behind. What the audience does not see is the fact that the curtain proper, which rises just before the play is to begin, is covered with black velvet on the front. After the appropriate music reaches the proper bar, a beautiful scene is flashed upon the audience without any previous preparation. This is a drinking scene and a number of characters in costume have speaking parts, then without a moment's warning, the scene as indicated in our Scene A of our small drawing, is disclosed to the eyes of the astonished audience. A few moments later Scene B appears. This time on the second level. These scenes continue to alternate with others, and what might be called "regular" scenes on the stage proper, the same as might be used in any theater, but the sudden appearance of the second level rooms and at A and at the other side of the theater stage is most entrancing.

The readers of the SCIENTIFIC AMERICAN are now to be given a rare treat and they are going to be shown how this work is actually performed. The great wonder is so much mechanism can be crowded on a stage which is only 34 feet deep, for unfortunately the block between 42nd and 43rd streets lacks depth, which makes it very hard for theaters often back to back to get a requisite depth to their stage.

First of all, a large, deep bridge was constructed, leading across the entire width of the stage and sliding on rails. On this bridge two single stages are mounted side by side. The opening of the arch of the bridge is covered in front and in back by black curtains. Behind this opening a third stage has been erected. This third stage can also be moved to the front on rails. Here, too, while playing in front, or on any one of the two stages resting on the bridge, a fourth stage picture can be built, same quickly appearing and disappearing; quickly assembled and dismantled.

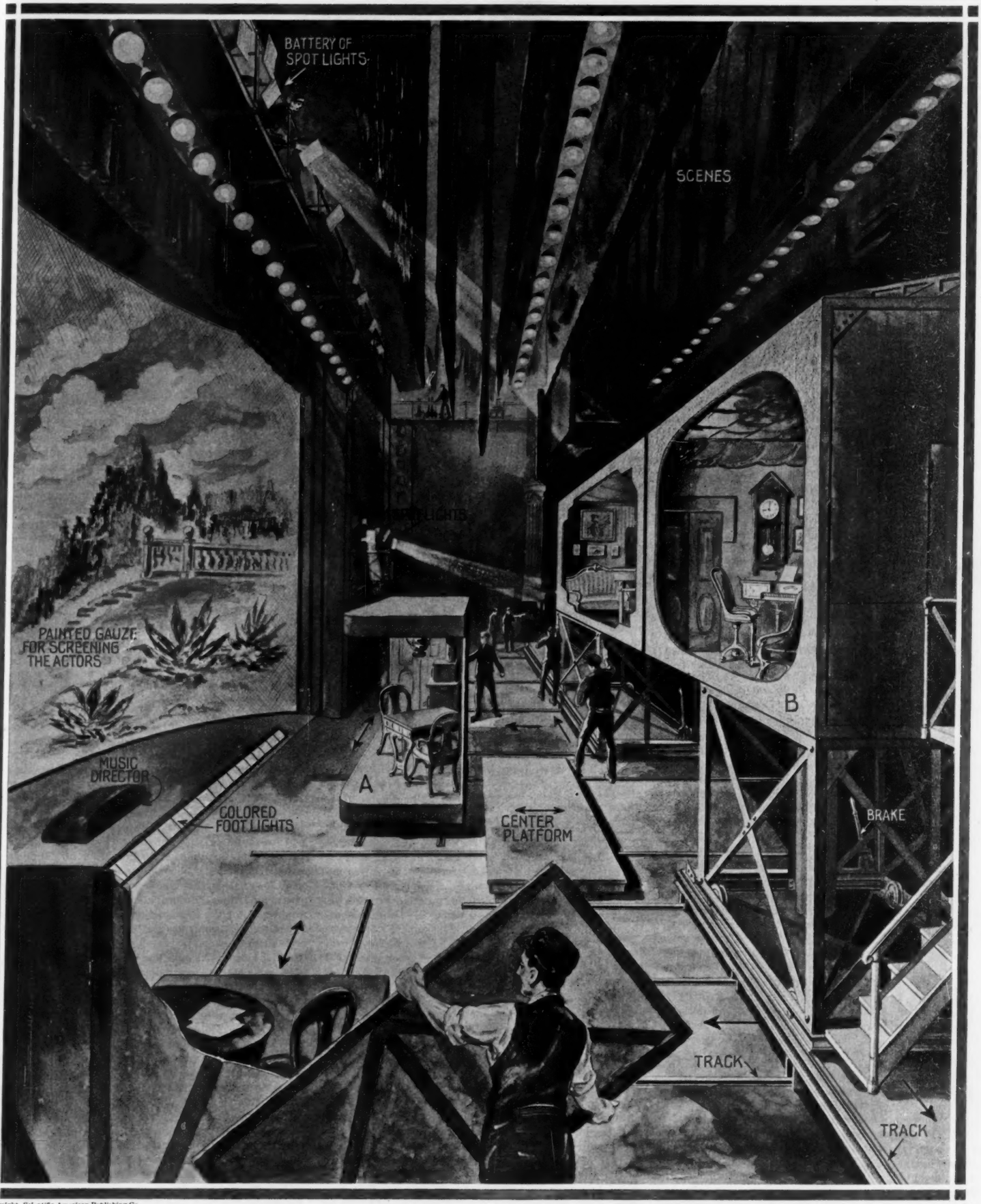
In front, to the left and the right of the main stage, two more stages are provided. These two stages are turned around a vertical axis. By turning the opening to these two stages backward it is possible to build there a stage picture, while the wall turned toward the main stage serves as a supplementary part. By turning both these side stages at an angle of 90 degrees their stage picture will face the audience. Thus there is a total of six stages each one being entirely independent of the other. This number can be still further increased to fit the demands of any production as will be presently explained.

The first thing which will be noticed in our view behind the scenes is the center platform on which the characters are seated in the Prologue. The whole platform is hauled back on its tracks at the same time that the room A is pushed forward on its tracks. As soon as the actors are in position of the room A, the lights flash up, giving the effect as indicated in our small drawing at A. This scene occurs a number of times throughout the play. The most interesting part of the mechanism, however, is the rolling "bridges," as they would be called in theatrical parlance. These bridges roll towards and away from the audience and upon them rest other bridges which have a "cross-stage" movement. The rooms, in which the scenes are enacted, might really be called super-structures built on the rolling bridges. These can be used for a great many purposes, other than the rooms, which remain set all the time. Thus, take for example, the iron work in B shown in our large engraving, is covered with black cloth and the actors can pass behind this masking without danger of their being seen. They can also be used for attaching scenery, so that they are very useful outside of their ordinary function. The rooms can be separated and run to the extreme sides of the stage, so as to give an unimpeded stage for the erection of stage properties, drop scenes, etc. The bridges and their super-imposed rooms move easily; in fact, two men can handle them where great speed is not necessary. A brake limits the motion, so that they are not run beyond a fore-ordained position. A staircase is at the end of each and is staunchly built as the actors are obliged to make quick ascents and descents, as for example, the star, Mr. Ben-Ami, must rush from the room B, change his wig and be in his chair on platform A in a very few seconds.

The lighting is, of course, very important. There are colored footlights which are necessary in some of the scenes, but the lighting effects are so unusual in this production that the ordinary spotlight is not speedy enough to catch the actors and also the effect of the spotlight is rather crude. This has been done away with by the use of mirrors on which the light is reflected from the spotlights and these alone are required on this light bridge to produce the effects. Owing to the fact that the sides of the stage are required for scenery, the men who operate the lights are obliged to reach their section by a rope ladder, which is afterwards pulled up. The music director and men in charge of the "cues" are behind a hood, which is in front of the footlights, and the orchestra is also below the level of the stage. The lights and the music are synchronized perfectly, the signals being given by electric flashes on various parts of the stage.

The scenic picture disappears with the same flash-like speed with which it appeared and the reflector lights up the next. While one stage is being played on, the workmen, clad in black, noiselessly change the scenery on the other stages, right in front of the eyes of an audience and with no consciousness on the part of that audience that such a thing is being done. Whatever lies outside the sphere of the light cone cannot be recognized from the auditorium. During the performance of "Johannes Kreisler" the six subdivisions of the one big stage are all in complete darkness except the one upon which the playing for that particular scene is transpiring. This one stage is lighted, but not by the accepted foot and top lights in general use in the theater. These customary lights are never used throughout the production except at such times when the main stage is used in its full width, the bridge of smaller stages being withdrawn and covered by a background. Each of the single stages has its own especial lights. In addition to this—and this is the main point—lighting systems, consisting of arc lamps and mirrors, are installed in the loft for stage machinery. In this manner only the one particular stage on which the action is taking place is spotted.

"Johannes Kreisler," with its 42 scenes thus produced has rendered splendid proof of the practical and effective nature of Svend Gade's mechanical and lighting innovations. But it also embodies many future possibilities. While the six stages are sufficient for "Johannes Kreisler," there may come other productions requiring double the 42 scenes of this production. In this case three bridges can be built, moving on rails in all possible directions. Instead of the one upper stage used in "Johannes Kreisler" two can be provided. Similarly the number of side stages can be increased. Thus it will be seen that Mr. Gade's invention solves all the problems of theatrical production which have puzzled managers as long as the theater has been in existence. In the presentation of Shakespearean drama, for example, it will be a thing of inestimable value.



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A MECHANICAL STAGE WHICH OPERATES IN ALL DIRECTIONS. A COMBINATION OF SINGLE ELEMENTS WHICH PERMIT OF THE MOST COMPLICATED EFFECTS. THE SCENE SHIFTERS ARE DRESSED IN BLACK, MAKING THE CHANGES UNDER THE EYES OF THE AUDIENCE

Our Point of View

Gliding Over Sea and Plain

THOSE critics who scoff at the idea that the airman will ever be able to maintain a gliding machine aloft for any considerable length of time above a plane surface of land or water, that is to say, anywhere except upon the hillsides, are assuming too much. No one, of course, pretends that gliding is possible above level country, irrespective of local weather conditions. On the contrary, it is only in certain localities, and under special meteorological conditions, that the soaring flight of the seagull or the buzzard can be achieved, and only then with a highly perfected glider and a pilot of unusual skill.

It is now well understood that even on the calmest day, when apparently there is not a breath of air stirring, there is nevertheless a vertical movement of the air, which may be rather loosely described as rising and falling in vertical and roughly parallel columns. It has been pointed out that evidence of this may be noticed on the surface of the sea on a hot and calm day, when patches of the surface will present a perfectly smooth and oily appearance and other patches will be slightly ruffled. It has been suggested that this patchwork appearance is due to ascending and descending currents, the colder and heavier columns of air roughening the surface of the water where they strike it, the intervening spaces being those below the rising columns of warmer air.

Now, if this assumption be correct we have an explanation of the ability of the soaring birds to remain aloft for long periods of time without a single flap of the wings. So long as the bird moves in an ascending current, it either ascends, or remains at the same level, or slightly loses altitude, according to the velocity of the rising column. Because of its long experience, or possibly because of some natural instinct, the bird is able to find and remain in the favorable currents, adjusting the angle of incidence of its wings to the velocity in such a way as to maintain itself at the desired altitude.

Now he would be a rash prophet who stated that man, with his relatively heavy and clumsy means of flight and at the very outset of his apprenticeship in the art of flight, will be able before long to match the soaring of the birds; for they represent the finished product of untold ages of evolution, and have at command an experience of almost equal duration. On the other hand, we must not forget that our present masterful attainments in mechanical flight have been reached in an experimental effort which covers only a few decades.

Although the art of soaring offers no promise of such practical results as have been obtained in military and commercial aviation, it is certain of a great future in the field of sport. An experienced yachtsman, who has lately taken up gliding, assures us that the peculiar charm of yacht sailing is felt in a far greater degree in a motorless airplane. There is the same sense of making the dynamic forces of nature subservient to one's will with practically no physical effort. He describes the sensation of moving silently through the air as appealing even more strongly to one's sense of mastery over the elements than does the movement to windward of a well-canvased and perfectly balanced yacht.

Cost of Stopping Freight Trains

THE railroads of today are suffering for the sins of their ancestors of the period when rebating, lobbying, free passes, and other abuses were rampant. Happily that era has entirely passed away, and if the over-severe legislation against the railroads (the outcome of public resentment) has made the profitable operation of the railroads a matter of great difficulty, it is only just that the public should know that every railroad throughout the country is now being run by its officials upon lines of the strictest economy. On any of our first-class roads it can be asserted that there is not a single department in which the costs of operation have not been cut to the very bone. Moreover, elaborate investigations are continually being made to determine with the greatest exactitude the costs of operation, even in the supposedly minor particulars.

As an example we may refer to an analysis which has recently been published in the *Railway and Locomotive Engineering Journal*, of what it costs a railroad company to stop a freight train of average size when it is running at certain specified speeds. In this study the cost of every movement involved in stopping a train was computed to the fraction of a cent, and in order to exactly determine the wages, the pay of engineers was taken at $1 an hour, of firemen at 77 cents an hour, of the conductor at 80 cents an hour, and of two brakeman at 69 cents an hour. The cost of stopping a train was estimated in the case of trains running at a speed of five, ten and fifteen miles an hour, and it was found that to stop an average freight train it cost 24 cents at five miles an hour; 69 cents at ten miles, and $1.44 at fifteen miles an hour. When we bear in mind that there are over 260,000 miles of track in the country and that most of this is to be found in the great centers of industry, where traffic is dense and freight trains run under close headway at speeds of generally over 15 miles an hour, it can be understood that a cost of from $1.44 up for every stop must amount to a considerable sum for any one day, and an exceedingly large sum for the whole year.

It should be noted that if a train is stopped on a descending grade the distance required to come to a full stop would be increased, but the time and distance required to accelerate the train again would be so diminished that the total cost would probably be less than that given. On the other hand, if a stop were made on an ascending grade the time and distance required to accelerate would be so increased as probably to increase the cost of the stop. If the stop were made on a curve there would be a still further increase due to the friction of the wheel flanges against the rail and to other causes. Such facts as these, distributed among the train, track and yard operating forces should lead to more intelligent operation, and to a marked decrease in railroad costs due to unnecessary train stops.

Early Days of Gun Versus Armor Quarrel

APROPOS of the construction of 40 million dollar battleships, we note, in *Engineering*, a reference to the fact that having had occasion to refer to their files for December 18, 1863, the editors were struck with the prominence which then, as now, was being given to naval matters. At the fourth session of the Institution of Naval Architects, there was a paper "on the construction of iron-plated ships," which recorded the progress in applying the lessons suggested by the French "iron-encased battleships" in the Crimean war. The paper, which was read by Mr. (afterwards Sir) W. Fairbairn, spoke of a long series of experiments which had determined that "the material which presents the greatest power of resistance to projectiles at high velocities is the softest and best description of well-wrought malleable iron." There was mention of tests of a 600-pounder Armstrong gun against a target representing a section of H. M. S. "Warrior's" side, and in spite of the fact that the softest malleable iron was considered the best material for armored plate, the on-lookers at the test were amazed at the results. In a note on the subject, says *The Engineer* (remember this was 60 years ago), it was stated that "since the great battle of gun versus plate had begun to be waged, there was never such a complete triumph for the former combatant." Another item in that issue of 1863 was an interesting account given of the American "Monitors"—reprinted from the SCIENTIFIC AMERICAN—a topical subject, says our contemporary, since only recently the "Monitor" itself had defeated the "Merrimac."

The story of the subsequent development in guns and armor and the long-drawn-out contest, in which supremacy rested first with the gun and then with the plate, forms one of the most thrilling chapters in the whole history of engineering. The answer to the gun was found first in iron and then in steel plates. When the latter was beaten, a hard steel face was welded upon a backing of softer but tougher metal. The gun won out again, cracking and breaking away the hard face. Then came Harvey and Krupp, who impregnated the face of a homogeneous plate with carbon, quenched the surface with water, and secured a surface so hard that the nose of the projectiles was shivered, preventing penetration. Chrome and other alloyed steel shells, better methods of heat treatment, coupled with the use of a soft metal cap, have finally produced a projectile capable of developing upon the plate, with full efficiency, all the energy that modern, high velocity shells can impart. Today, as in the crude experiments of 1863, the gun is supreme. At the battle of Jutland, the armor-piercing shell found no difficulty in penetrating the most modern armor.

Bridges Versus Tunnels

PUBLIC attention has recently been drawn to a paper, read some months ago by Professor Burr of Columbia, on the subject of bridges and tunnels for the Metropolitan district, in which he favored the driving of many tunnels as against the erection of one or more bridges. The discussion is rendered very timely by the fact that, recently, the Commissioner of Bridges has recommended the construction of a $42,000,000 bridge across the East River, located between the present Manhattan and Williamsburg bridges, while the Rapid Transit Commission, through its chief engineer, Ridgway, has stated that four twin-tunnels could be constructed for the same cost as the proposed bridge, into which all the Rapid Transit tracks on the three lower bridges could be diverted, leaving these bridges entirely free for vehicular traffic.

In any discussion of the relative value of bridges and tunnels, a sharp distinction should be made between the problem as applied to the Hudson and the East Rivers; this for the very good reason that neither of the alternative tunnel and bridge schemes proposes the transfer of freight trains across the East River; whereas, one of the most important elements in the Hudson River problem is the transportation of freight trains and main line through passenger, as well as commuters' trains into Manhattan Island. What gives the proposed Hudson River bridge such a commanding lead over any possible scheme for separate tunnels, is the fact that in addition to providing for 20 lines of motor trucks and automobiles, it would also provide, on a lower deck, 12 tracks for main line freight and passenger trains. To provide the same tunnel capacity would call for the construction of eleven double tunnels under the Hudson, whose total cost, judging from the cost of the vehicular tunnel now under construction, would be about 300 million dollars, as against a cost of about 150 million dollars for a single bridge of equal capacity.

On the other hand, the tunnels being placed at intervals down the waterfront would have no such advantage of avoiding local congestion and ensuring a more even distribution of the traffic, as claimed by Professor Burr; for the Hudson bridge vehicular traffic would radiate over four or five new highways diverging from the Jersey end of the bridge, and on the Manhattan side the traffic would be delivered immediately by ramps to five of the main north and south avenues. The trunk railroad passenger traffic would run to a single union station, serving all the western railroads, and the freight traffic would be carried down West Street on an elevated roadway, to deliver its freight either direct to ocean steamers or to a line of warehouses on the east side of West Street.

In the conclusion of his paper Professor Burr makes the unfortunate mistake of seeming to suggest that the

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proposed bridge would connect the elevated lands on both sides of the river in the general vicinity of 179th Street, and therefore would contribute directly to the advancement of a limited suburban district west of the Hudson in the vicinity of the landing. As a matter of fact, the crossing will be in the vicinity of 57th to 59th Streets, and advantages to suburban travel will be felt throughout a radius of 30 to 50 miles in New Jersey; while the benefits in the expediting of freight-car traffic and merchandise between the Jersey side and the general Metropolitan district, to say nothing of the great lessening of terminal costs, will be felt in every center throughout the United States that has occasion to ship freight to or through the city and Port of New York.

Is the Battleship an Economic Loss?

A FAVORITE argument of those who would have us stop all naval development and subject ourselves to complete disarmament is found in the assertion of the pacifist that every pound of steel that is built into a warship, and every sailor who does service in the Navy, represents an absolute economic waste. The enlisted personnel, we are told, is a body of men who are taken from useful industries and condemned to a life of idleness that brings no useful return to the nation. The steel which is worked up into hulls, guns and ships, represents, we are asked to believe, a loss of material which might have been fabricated into plowshares, locomotives, and ships of the Merchant Marine.

Fallacious reasoning, every word of it. The young men who spend from two to four years in the Navy are taught those very lessons in discipline and obedience, which are so greatly needed by the youth of today. This training is of such inestimable advantage in after life, that we could wish it were possible that every young American could have a few years of discipline as strict, just, and kind, as that which our sailorman experiences at the hands of our naval officers. So marked is the influence, physical and moral, that one can almost identify, in his subsequent civilian life, an enlisted man who has spent four years or more in that great training school of obedience and discipline—the Navy.

We do not find the pacifist raging against our great insurance companies, with their vast army of employes. Why then should they so persistently snarl and chatter against that greatest of all insurance agencies, the Navy; for whereas other insurance agencies have to do with the individual man, or the individual property, naval insurance has to do with the whole nation—all that it is; all that it has; all that it stands for.

Nor do the warships which guard our shores and uphold our civilization represent a great economic loss. Not only is the "Maryland," the flagship of Admiral Jones, a great public school in which the men are taught to live up to certain fundamental standards of honor, hard work, and fair play; but the great ship itself, could it only speak, would tell of the scores of thousands of American workmen whose years of fruitful labor have been embodied in its huge fabric. Were the ship vocal, it could speak of the thousands of American workmen who mined the ore, who smelted it down and forged it into steel shapes, armor plate, guns, and all the other elements which go to make up a modern battleship. It would tell also of the other thousands of men, who in shop and forge, and on the building ways, put the great fabric together until it stood ready for its final launching.

An interesting commentary on these facts is found in a recent statement in the British Parliament, regarding the two 35,000-ton battleships which Great Britain is about to build under the sanction of the Washington Treaty. Each of these, by the time it is completed in 1926, will have cost $40,000,000. That country, therefore, with 1,400,000 unemployed, is welcoming the commencement of these ships as affording no inconsiderable relief to their present distressing labor conditions. It was stated by the First Lord of the Admiralty that 500 separate firms will be engaged in supplying the materials; that during the first three months about 4500 men will find employment; that by the end of the year the number will have risen to 29,000; and that for a time during the later period of construction, the building of the two ships will give work to 40,000 men, the total bill for wages amounting to $50,000,000.

The size of the navies of the United States and Great Britain, as determined by the Washington conference, is sufficient for peace-time security. The far-seeing and patriotic among the citizens of both countries will resist any pacifist effort to reduce this naval strength, either in men or materials, below the standard agreed upon. In regard to the cry that the ships and the men represent an economic loss to the country, they will answer that the Navy is at once an insurance against national physical disaster and one of the surest depositaries of the traditions and principles of the true historical America.

The Centenary of a Great Waterway

THE people who dwelt on the shores of New York Harbor, in the year of our Lord 1823, might have witnessed on October 8 of that year the progress through the upper and lower bay of a veritable armada of ships. In this fleet were to be seen craft of pretty well every description that could be found afloat along the shores of the United States 100 years ago. Conspicuous, of course, were those maritime wonders of that day, the steamships; for it was not over a decade and a half since that ever memorable day when Fulton's steamboat, the "Clermont," had made her memorable maiden voyage from New York to Albany and back.

If a visitor from one of the countries of the old world had been standing at Sandy Hook on the day referred to, he would have seen the head of the procession pass out through the channel, and on the deck of the leading ship he would have seen somebody lift above the bows a vessel containing water and pour its contents into the sea. He would have seen the vast array of vessels, after the completion of this act, turn and make its way back into the harbor. Doubtless he would have been mystified. Had he been an ancient Greek or Roman, he would have been satisfied that he had just witnessed a libation to the Gods. All Americans who are familiar with the history of New York State will recognize from the above description the ceremonies which attended the opening of the old Erie Canal, when a jar containing some water from Lake Erie was brought down by barge through the canal, taken out beyond Sandy Hook and emptied into the Atlantic, thereby symbolizing the linking up of the fresh waters of the Great Lakes with the salt waters of the Western Ocean.

The centenary of this event, which was so pregnant with promise for the future of the commercial metropolis of the western hemisphere, will take place during the present year, when there will be a historical pageant on Lake Champlain in commemoration of the original opening. In this connection we draw attention to a work, "The History of the Barge Canal," written by Noble E. Whitford, senior assistant engineer of the canal, under the authority of Frank M. Williams, state engineer and surveyor.

We commend this publication as of the greatest interest to shippers, engineers, and others interested in the development of American inland waters. The new book is a combination of the author's earlier work, known as "The History of the New York Canals," which dealt with those waterways up to 1905. The present history gives complete information relative to the campaign conducted for canal improvement in 1905; the difficulties encountered in constructing the channel; the use that has been made of it. There is also a complete and very richly illustrated description of its many notable structures. We note also a brief review explaining the attitude of New York State toward the St. Lawrence ship canal bridge.

More on Braking with the Engine

LAST month we showed that when the autoist talks of "running on compression" he is guilty of a misnomer. We showed, by exclusion, that the braking power of a dead engine must reside in the intake and exhaust strokes. And we promised a further discussion that would show, affirmatively, that it can and does there reside.

To one who knows just enough to get him into trouble, it seems that the inner face of the piston is open to the atmosphere through the valve, and its outer face through the crank-case breather; that throughout the intake and exhaust strokes there is accordingly atmospheric pressure on both faces; and that no work is done on these strokes other than the mere overcoming of the piston's inertia. The fact is, of course, that if this picture were true there would be no pressure on the front of a racing car and no vacuum behind it; no pressure on the under surface of a plane and no suction on its upper face; no power consumed by the operation of a fan—that most things, in fact, would be other than they are. It is illuminating to speak of the dynamic compression and rarefaction produced in immediate contact with a surface that moves through the free air, as distinguished from the static compression and rarefaction created in a closed chamber behind the face of a moving ram. We move the air out of the cylinder, on the exhaust stroke, by pushing it out, against such a dynamic resistance; similarly on the intake we suck it in. We pump the air in and out, in other words; and the pressure to be overcome, and the work done in overcoming it, are roughly proportional to the square of the air-velocity induced. Any other viewpoint involves the fallacy of regarding the air in the cylinder as a rigid, solid body.

With this point settled, then, where shall we set the throttle for maximum braking power with a dead engine? At given car speed, the engine must turn over at a stated speed of its own. To do this, it must either draw into each cylinder its full capacity of air; or else fill the cylinder but partly on each intake stroke. In the former event, it would have to work harder to drag in the necessary air through a closed throttle than through an open one; and the cylinder once filled, the exhaust stroke would be unaffected by what had gone before. We do not believe that this is what happens, in a dead engine any more than in a live one; but we mention it merely to cover the matter completely.

In the more probable event that the extent to which the cylinder is filled depends upon the degree of throttle opening, the pressure in the cylinder at the moment of bottom dead-center and valve-closing is less than atmospheric—that is what we *mean* by an unfilled cylinder. But in this event the intake stroke will have been completed against a real, live, unsatisfied vacuum, with obvious results in the consumption of power. One is tempted to say that this will be offset on the exhaust stroke, by greater ease of evacuating a less-full cylinder. But one forgets that the moment the exhaust valve is open, air flows in from the exhaust manifold until the full atmospheric pressure is attained, and exhaustion must then proceed not only against this full atmospheric pressure, but also against the inflowing current which has thus been set up.

It will be clear from this discussion that there is not much difference between the braking power of a dead engine with full throttle and with throttle closed; but that what advantage there is, resides in the closed throttle. This does not mean closed tight so as to pass no air at all—it refers merely to idling position. But it is interesting to note that even with a sealed throttle, there would be considerable braking effect. The intake stroke would proceed against a very heavy vacuum; and the exhaust would be met by a very active in-flow through the partly opened exhaust valve.

Left: The Flagg system by which rubble walls are built with a simple form by laborers, thus eliminating the skilled work of the journeyman mason. It is a cross between pouring concrete and making a masonry wall the result being a good job that has all the beauty and strength of ordinary masonry. *Right:* Close-up view of Flagg masonry wall in course of construction. Note the stout wooden framework which holds the boards of the mold firmly in place

Pictorial explanation of how masonry walls of attractive appearance may be produced by ordinary labor

More House for Less Money

Deviating from Building Traditions in the Face of High Building Costs

By Harold Cary

THE construction of the small house today utilizes a heritage of traditions upon which are piled many convenient but not essential improvements. We are building in much the same manner as our forefathers, if we build well; and in the face of high building costs the amount of money that can be invested in even the most modest bungalow is startling, to say the least. On the other hand, any effort to escape from high building costs has generally resulted in the production of unsatisfactory and even dangerous construction. And no one realizes these facts more than the architect and the builder, for they are face to face with the situation in their daily work.

Persons of an inventive mind have not been slow to appreciate the anachronism of certain building traditions, especially in the case of the small home builder. Of recent years numerous patents have been issued for improved methods of construction designed to produce a better home for less money. The American Institute of Architects has been fully aroused to the seriousness of the situation and has taken steps to solve the building problem for the average man. But no one has been more active in this connection than Ernest Flagg, the architect, who, under the lash of his own feelings for simple beauty of construction and design, has produced several remarkable improvements in small house building.

Ernest Flagg is that resolute and implacable artist from whose board sprang the first of the great towers which characterize Manhattan's famed skyline—the Singer Building. He is the designer of the Naval Academy at Annapolis and of many well-known architectural works such as the Corcoran Art Gallery at Washington, D. C. But the real interest of Ernest Flagg, just now, is not in the great public building or the mansion in which cost is the element of least importance. It is in the house which costs its owner from three thousand to fifteen thousand dollars. For the past 20 years he has been experimenting with ways for improving its design and the construction of its units. He is able now to build houses for ten thousand dollars which, so it is claimed, would cost a full twenty thousand dollars if produced by the usual conventional methods. He has been able to devise plans which, using ordinary methods of building, save a third of the cost, making possible the building of a house for six thousand dollars which, to provide the same cubic useful content, would cost nine thousand dollars or more if drawn conventionally.

Flagg, like Ruskin, is a hater of sham. He believes that sham is always ugly. He goes straight back to first principles, as every inventor must, and examines the reasons for the existence of everything in which he is interested. If he likes he may boldly throw away a thing which we are accustomed to regard as an essential. He begins the design of his small houses by first completely discarding both the cellar and the attic.

You can imagine this architect examining the various items in the expense of building. A cellar costs usually about 20 per cent of the total cost of a house. Why do we have cellars at all? Once, of course, they were used as refrigerators and contained great storage spaces for a winter's supply of vegetables. They were cool and damp. Then somehow the belief grew that a damp cellar kept a house dry. Yet dampness pervades the house just as surely as coal gas does after improperly stoking a furnace in the cellar. A cellar was supposed to keep a house warm, which it does not unless you have a furnace which most extravagantly heats the whole cellar. So long as you have a proper floor and a tight foundation a cellar is an extravagance, so claims Flagg in the face of a great deal of opposition.

To take the place of a cellar this ingenious architect adds above ground storage space in which furnace and coal bin are housed at very much lower cost. Either hot water or steam heat can be as easily arranged on the ground floor as underneath the house, and he is experimenting and is using himself a warm air heater with a small fan in the incoming duct, which arrangement has proved satisfactory. The necessity of climbing up and down stairs to tend the furnace is done away with. The mass of the house is increased—always desirable from the standpoint of appearance. Beneath the floors, while the house is being built, concrete is laid on the ground and given a coat of waterproofing which extends clear across the foundation walls to make a coursing. This provides a watertight construction which also prevents molecular attraction in the stone walls from rising above the ground level. There is a small cubic area of dead air space between the concrete and the floors. Dryness and warmth is much more certain than were you to try to build a cellar.

The attic in most houses is either useless space or expensive and inconvenient storage space. It costs from eight to ten per cent of the total cost of the house and on the whole is unjustifiable. It is supposed to keep a house warm in winter and cool in summer. As a matter of fact it is a large, roofed space which may absorb much of the heat generated within the house in the winter time. And it is valuable. In either one or two-story houses Flagg runs his rooms to the roof peak and provides a ventilator, which he has perfected, to keep the room cool in summer. These ventilators take one of two forms—an attractive ridge dormer, or a small, cheap skylight which opens and is screened. Because hot air rises, when these openings are free all the air within must be as cool as the air outside the house. The stifling hot attic is eliminated.

The ridge dormer, illustrated on the facing page, is a square box-like opening on the roof peak at convenient points. It is usually kept open all summer but can be closed by means of a pull on a cord which swings the glass window shut. The ventilator, which is a cheaper substitute, is a hot-bed sash with copper flashing, a single strip of copper forming the hinge on one end and serving also to keep out water. People may be skeptical about such a simple arrangement and the only answer to them is that they have been used for years in Mr. Flagg's own houses,

BUILDING costs are higher than ever before. Materials and skilled labor are commanding prices which bring up the cost of the most modest house to an almost prohibitive figure. A six-room house in pre-war days could be constructed for $3500, exclusive of the land; today the same house costs at least $6000, and, if the numerous refinements so much in demand are crowded into the same little house, the cost mounts up rapidly to $10,000 and even $12,000.

Never before has there been such an urgent demand for new kinds of material and new methods of construction in the endeavor to produce good houses at moderate cost. Inventors have not been slow to direct their efforts toward this lucrative field. More and more we are breaking away from building traditions which have in many instances outlived their usefulness, and substituting novel ways of building more in keeping with the times and with conditions. In the accompanying article Mr. Cary tells of the work of Ernest Flagg, the well-known architect, along these same general lines. Mr. Flagg has studied the problem of the small, inexpensive house for the past twenty years and has evolved many new ideas. Whether his ideas, especially those of a quite radical nature, are to be followed in preference to the conventional methods, is for the reader to decide, for we are not called upon here to endorse them. But Flagg's ideas point out a different way to go about home building and must therefore be instrumental in stimulating still other ideas which may be most opportune at this time.—THE EDITOR.

and tenants have found them thoroughly satisfactory in every way.

Because the stone house is fireproof and permanent and cheapest to build in the long run, Flagg uses stone for walls exclusively. He has invented a way of laying rubble stone walls, which are quite beautiful, without the help of stone masons. Also, he has cut the cost in the neighborhood of New York from 45 cents a cubic foot to 6 cents a cubic foot. This novel stone construction starts in the trench for the foundation wall, with dry stone. When a foot has been laid cement is shoveled in and from there on up to the ground line the wall is of ordinary masonry which can be laid by a laborer in an open trench. At the ground line or a few inches above, it is finished off for the coursing of waterproofing compound. From here on the work is more like pouring concrete than masonry.

Forms are erected which consist of four by four uprights as high as the finished wall is to be. At the top an alinement truss holds them, and at intervals all the way down twisted wire spacers are used. Three 8-inch planks are slipped into position at the bottom. Workmen lay stone with the straight face out, each against the board forming the box. Concrete is shoveled in behind these face stones. This section of wall, two feet high, is then left over night. In the morning the planks are lifted up to the height of the wall and secured with pins. Another section of wall is laid all around. Window frames are set by the foreman as the wall is built.

While it would not pay to build a set of four by fours and trusses for one very small house, it would pay for two or more because no matter what the size of the house the same forms are employed and they come to no harm in actual use. The wall when completed must be pointed on both sides, an operation which is performed by holding the mortar board at right angles and pushing the mortar into the spaces between stones. It may be of advantage to use a mason for this one brief job. Flagg's walls are, of course, very low because he utilizes all the space under the roof and because the house is not lifted on a high foundation. His practice is usually a five-foot wall for one story and a twelve-foot wall for two stories. Thus he readily achieves the effect of the low dwelling, sturdy and well anchored, that modern architects so often unsuccessfully attempt.

The most amazing invention which this inventive architect has made is of a new kind of a partition. The ordinary one is generally about six inches thick and is a series of flues for fire. It is expensive from start to finish. In space wasted, alone, a partition can be figured to cost $3 a running foot, minimum. Flagg partitions are only about an inch and a half thick, yet they are as soundproof or more so and plenty strong enough.

Along the beam where the partition is to go Flagg hangs widths of jute scrim from screweyes. These are basted together to form a curtain. Two plasterers, facing each other, work against each other's boards and put on a first coat. This curtain then hangs plumb and is slipped into a special baseboard to fit. Then the next two coats of plaster are put on in the usual way. The resulting thin partition has been given every possible test in use and in the laboratory. The New York Building Department, which formulates the city code, tested this partition before permitting its use some 10 or 15 years ago in a New York tenement house of model design. In this test cord wood to a height of two feet was soaked in kerosene and ignited in a closed room of the test building, the walls of which were formed in the way described. After the interior had been burning long enough to have consumed ordinary partitions, a fire hose was turned on the hot walls from outside at high pressure and no damage was done to them except for the development of a slight bulge and a tiny crack. They were okayed for use. The writer, being skeptical about the strength of such partition construction, pounded one of these walls with his fist as hard as he could and was unable even to vibrate it. Their economy is obviously self-evident.

Roofing is one of those things in which we have made some improvements in the past century, but even in these Flagg has devised a method for using them which is better looking and cheaper to install. He first cuts 36-inch, roll roofing into strips nine inches wide. The second strip of roofing is nailed on with only a two-inch overlap, a metal clip being placed under each nail. Each nail is covered by the succeeding strip of material, only the clip, which is bent over the edge of the next piece to keep it tight to the roof, is exposed to the weather. The nails are put in so that the clips form a straight line at right angles to the edge of the strips of roofing. The finished roof weathers, forming a thin streak in line with the clips. In a year the roof is divided into perfect squares and is actually beautiful. In 15 years of service, using the cheapest sort of material, no leaks have developed, according to report. The edges of the roof are faced with a copper or lead band, nailed on.

Although inexpensive construction is the main object in this cottage, it presents a pleasing appearance. Skylight ventilators as well as roof dormers are here used for ventilation purposes. The chimneys, it will be noted, are made an integral part of the wall. The porch is directly on the ground, with a brick floor

A stone cottage which may be constructed at a cost not exceeding frame construction

Typical Flagg stone cottage, showing how his inexpensive roof weathers and becomes quite attractive. This roof has been in place for the past ten years. The roof dormers, which make possible the use of the space under the roof, show plainly along the line of the roof peak

Combining inexpensive construction with attractive appearance

Again our inventive architect finds that rain gutters and leaders are ugly to the eye and in most places quite unnecessary. He simply leaves them off the houses he builds. Around the walls he puts a narrow concrete walk which carries off the water as it falls from the eaves. Only above a terrace or in a similar place does he permit gutters. He trenchantly says: "The design of many a house has been ruined by numbers of great ugly tin pipes running down the walls or down pillars which otherwise would be beautiful in every line."

There is room to describe here but a few more of his economies. He says himself that he has been able to effect them in every part of the building except in electric light wiring. He tackles plumbing, screens, ceilings, beams, casement windows and so on. In each case old conventions drop by the wayside and his simple, rugged houses result. One or two details among these are so interesting that they should be mentioned. Take the case of the fireplace. Most of them simply cannot be expected to give out any heat. They are expensive. A Flagg fireplace on the other hand, not only heats a room very well, but also costs but little. For twenty-five or thirty dollars he builds what would cost from two hundred to five hundred, ordinarily.

A chimney rides on the roof peak of the gable, practically a part of the stone gable itself. A slight indentation in the thin building wall — six inches at most, is lined with fire tile. There is no chimney of stone and mortar below the roof. A hood of the size required is hung out from the wall at the proper height. From this hood to the chimney in the roof extends a bronze or copper half-cornucopia. The fire is thus open on three sides. The bronze or copper chimney is a remarkable motif for the decoration of the room. Most important it is a great hot box which heats the room the way a stove does. In a large house which is now being finished the bronze sheeting and hangers for the hood cost in New York just $12.50. This odd chimney was cut out of a single sheet so as to make three pieces, which were then riveted together.

The problem of the stairway is one upon which this architect has put a great deal of thought. It is one of the most expensive built-in pieces of furniture which we use. The stairway in a great many millions of American houses is not only expensive and wasteful of space in itself, but is also a creator of waste by requiring long upstairs halls. It is usually thoroughly ugly. In Europe for centuries a practice often used has been to have vertical communication instead of longitudinal. Halls are thus eliminated. Now that even our small houses are built with two baths or more, one of them for the use of the servant, we could adopt this principle if stairways were not so costly.

Into a concrete form Flagg pours cement and forms a step. With a series of these he builds a circular stairway at very low cost. It is so designed that it is easy to use; and in his houses, since the walls are low, the height of these stairways is not forbidding. The space they occupy is indeed very small. In building them, the steps are stacked upon each other and then cemented together. They are so cheap that you can have one wherever you would find it convenient in the house. You will be amazed at how two or three of them at most in a small house will cut costs and simplify your general design. Moreover they are amusing and unusual—fireproof, of course.

In general, then, it is this architect's principle that sham is ugly and expensive. His beams are nicely finished and the members actually used for support are visible to make a beautiful ceiling. It is a far different method than that which we use so often of covering the load-bearing timbers with plaster and then putting in fake beams at great cost as we strive for an effect. Similar shams are used to cover up the honest window frames. A decorative box which the trade calls "trim" encases the real frame. It is expensive and not pleasing. The real thing, always visible in a Flagg house, is a little more finished than usual and imparts a neatness and a Ruskin-like beauty which sham can never give. As you read this look at the nearest door or window. Is the decorative box that incloses the honest member within an addition? It serves no purpose.

Small houses following the unique ideas described have been built and have proved quite satisfactory in actual use.

Our Psychic Investigation

A Few Words About Apparatus We Shall Use and Ways in Which We Shall Use It

By J. Malcolm Bird

A typical arrangement of the recording chronograph, an instrument which will be called upon repeatedly during the progress of the Scientific American's seances

PERHAPS the reader pictures it as a simple matter to clear the decks and lay in all necessary material for a series of carefully conducted seances? Perhaps it is the general impression that one can decide today to hold such an investigation, decide tomorrow what is needed in the way of equipment, devote the next day to shopping, and start sittings that evening? We will put it on record now that if anybody believes these things, he is wrong.

The New York members of our committee held an informal meeting the other evening, to discuss these questions. The session lasted until the suburban members had to leave in great haste to catch their last trains; and even then, the secretary would have spent the night at a hotel if he were of such age or build as to forbid a three-block sprint from subway to ferry. Incidentally, even with this late sitting, Houdini and Dr. Carrington were left in argument over some of the details that hadn't been disposed of, and we don't know how late this *did* last.

Arrangements have been made with a downtown office building for a room in which to hold our seances. We shall not be able to paint the walls black, since we are not guaranteed the same room for all seances; so the walls will be covered with black cheesecloth, and the windows with similar hangings. This does not imply that the seances are to be conducted in black darkness, but merely that the necessary control of illumination demands that all light from without and all reflected light from within be excluded. We must have light when and where and to the degree desired, and only then and there and to that degree. Hence these black hangings will be part of the permanent equipment of our psychic investigators.

The term "cabinet" is misleading to one not accustomed to the seance room. It does not mean a box or a piece of furniture, with which tricks might be expected of the sort that a conjurer employs in one of his disappearances. With the reservation that we do not know what we are talking about, and that the analogy is therefore not necessarily a sensible one, it is in order to argue that, in dealing with electricity, we find it takes more energy to charge a large conductor to its capacity than it does a small one; that it seems rational to suppose that the same condition exists with the psychic power, of whatever nature this is; that the medium has to operate in a charged space; that she can with less drain upon her energy charge a small space than she can the entire room. So we cut off some convenient corner of the room, and allow her to confine her work to this space; and to this restricted region in which the medium operates the term "cabinet" has become attached. A mere curtain extended diagonally across the corner of the room has been found sufficient, and this is all that is implied by the use of the term in psychic work. So to the hangings for walls and windows must be added a curtain for the cabinet.

Lighting arrangements must be under full control. For use when the regular lights are turned off, we shall have a battery of red bulbs of rather high candle power. In the circuit leading to each lamp will be a variable resistance member, so that the intensity of each lamp may be cut down to any desired point by touching a switch. Using one or more of these bulbs in combination, we shall have a very wide range of red illumination, in addition to the ordinary lighting of the room when that is appropriate.

For furnishings, there must, of course, be chairs; and our psychic advisers are unanimous that these be cane-bottomed and without cushions. We shall have a table with a history—none other than the one Palladino levitated. While we do not wish to draw any picture of a medium trussed up like a roast fowl, in the center of a circle of enemies, rope is a recognized property of the seance room. The plain black garb for the medium may be on the order of a bathing suit or of a potato sack—we have not decided which style we shall adopt. We shall have luminous-spotted strips of cloth for pinning upon the arms and legs of the medium, to show throughout the seance where these members are. This is something new, having been introduced into the technique of the seance room by Willy Sch., the brilliant young German medium; and we trust that other mediums will find it equally possible to work under this control. We must have a mosquito-net gauze for the purpose of caging the medium when caging is in order—the ordinary cloth net, not the metal, which is regarded by mediums as a sort of non-conductor.

Another recent innovation is the practice of getting paraffin casts of materializations. A supply of paraffin, an electric toaster for melting it, a few pans for its handling—this is all the apparatus called for here. A liberal supply of vessels must also be on hand, with drinking water, warm and cold water for personal use, etc.; for the exercise of the mediumistic power is often accompanied by unpleasant physical reactions.

Of the actual scientific apparatus the simplest, of course, is the camera. We shall not be allowed to use flashlight powder; so we shall have to content ourselves with a powerful electric flashlight. The only drawback of this is the lag in its attainment of full power, and this can be controlled.

A constant friend to the psychic investigator is his scales. This instrument must be of the spring-controlled type, and must settle down to a steady reading with a minimum of oscillation. At the same time, such oscillation cannot be entirely eliminated; and for this reason the scales ought to be furnished with a recording attachment.

This brings us to that very handy instrument for which the French have devised the telling name of chronograph. With uninked stylus on a smoked drum, or with inked stylus on a drum of paper, this device records the successive states of any instrument to which it may be connected. No human eye can follow or human hand record, with accuracy, the successive readings of a moving needle or dial, at a time when the attention is distracted and the interest held by the other details of the experiment that is going along. The chronograph attends to all this for us; with its parallel records of time and action, it enables us to postpone to a moment of calm leisure and an atmosphere of no distractions the important task of reading our instruments; and it gives us a permanent record to which we can refer back for verification of a questioned or questionable reading. Its range of application is without limit; any instrument that registers anything, in any way, can be hitched up to the recording drum and made to write down its record for later examination.

Not the least interesting of the apparatus will be the electric devices of various sorts. There will be induction coils, galvanometers, electroscopes, etc., some with the purpose of testing the electrical condition of the medium at the moment when phenomena are produced, others to prove the presence or absence of material objects at certain times and places. Such of the furniture as may be subjected to telekinetic movements will be equipped with electrical contacts, and in this manner the time and duration of levitations and other vagaries will be recorded.

The mention of apparatus for detecting the presence of objects brings up other possibilities, some of which may be mentioned here, though they are not yet fully worked out by our committee, and though we do not, therefore, know just what use we may be able to make of them. During the war, instruments were devised that would respond to the heat radiated by a single human body at a distance of a hundred yards or more; and others that would send out sound waves and on receiving them back, indicate the distance and direction of the object from which they were reflected. Either or both of these methods are subject to the disadvantage, when used in the seance room, that some means must be provided of distinguishing between their response to the presence of the various investigators, of the furniture, etc., at points where they and it are properly supposed to be, and its response to clandestine movements or extraneous presences.

(*Continued on page 214*)

WE have no space to repeat in detail the conditions for our psychic award, published in full in our January issue. For the general convenience, however, we repeat here the more vital points of this announcement.

The SCIENTIFIC AMERICAN *will pay $2500 to the first person who produces a psychic photograph, under its test conditions and to the satisfaction of its Committee of Judges.*

The SCIENTIFIC AMERICAN *will pay $2500 to the first person who produces, under its test conditions and to the satisfaction of its Judges, an objective psychic manifestation of physical character, other than a photograph, and of such sort that permanent instrumental record may be made of its occurrence.*

The Committee of Judges shall consist of Dr. William McDougall, Dr. Daniel F. Comstock, Dr. Walter Franklin Prince, Dr. Hereward Carrington, and Houdini, the conjurer. In the event of death or other disability, a temporary or permanent substitute for any Judge may be named.

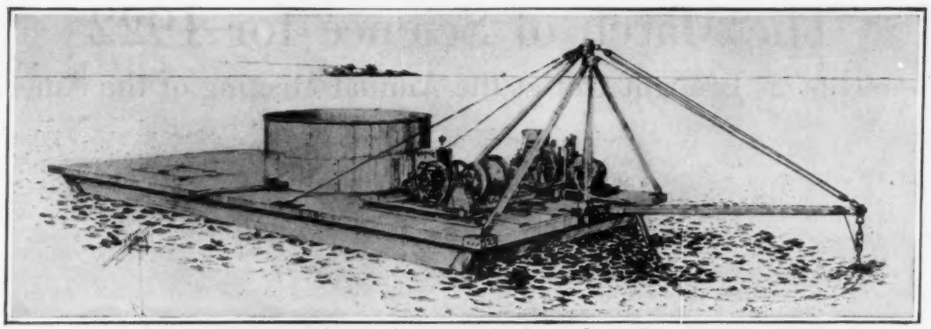
Entry must be made on or before December 31, 1924, to J. Malcolm Bird, Secretary to the Committee, at the SCIENTIFIC AMERICAN *office in New York.*

Either award will be made on unanimous vote of the Judges, or on a four-to-one division. Seances with any medium shall terminate and all his claims to the award be vacated upon rejection of his mediumship by formal vote of the Committee.

All the conditions governing entrance, the holding of seances, etc., which are laid down in the full announcement of our January issue are part of this offer.

Skimming Fuel Oil from Harbor Surface

WASTE fuel oil in harbors has become such a world-wide menace that port authorities have been keenly alive to efforts directed to the elimination of this floating peril. For this reason the success of Baltimore's newly devised outfit for the removal of the surface oil has attracted widespread attention. The apparatus includes a pump, mounted on a scow and operated by a small engine. Connected with this pump is a submerged pipe with its specially designed mouth coming to a point an inch or so below the surface of the water. When the pump is in operation the mouthpiece does the work of an inverted vacuum cleaner by sucking up the surface oil and water. The liquids are carried to the scow by the pipe, and discharged into a settling tank. After settling to the bottom, the water is drawn out of the tank by an outlet pipe and the oil is then removed to be burned or stored. The outfit was designed by Bancroft Hill, harbor engineer and president of the Harbor Board, and many port authorities believe it has solved the problem of surface oil.



A scow, a pump, a length of hose and a suction intake at the surface, skim waste oil from Baltimore Harbor

Baltimore's need for such an outfit was emphasized by an experience involving a waterfront fire, soon after 10,000 gallons of fuel oil had been released in the harbor by the sinking of an old hull in which the oil was stored. Fire department officials found that the loss was doubled because the surface oil carried the fire underneath piers. The new scow-pumping outfit is the result of the city's efforts to minimize menace of this nature.

The scow will answer calls in the same manner as is done by a fire-boat. Constant patrol of the harbor by an inspector is maintained for the detection of surface oil.

Optical Specifications for Glass for Balloon Hangars

THE first specifications to be prepared by the Government covering window glass for use in balloon hangars were written apparently without reference to the difficulties that might be encountered in carrying out the necessary tests, as they were so worded as to require testing the effectiveness of the glass in excluding ultra-violet and infra-red rays by using sunlight as the source of radiation for the necessary measurements. This procedure is inconvenient in view of the fact that the tests cannot be made at any time and in any place.

In order to put this work upon a convenient testing basis which could be carried out in the laboratory, the transmission of these glasses was determined by the Bureau of Standards also for various wave lengths using the ultra-violet emission spectrum of the quartz mercury-vapor lamp. From these tests it was established that if a colored glass or clear glass covered with asphaltum paint is to exclude 80 to 85 per cent of the ultra-violet rays of the sun, its ultra-violet spectral transmission (Tr including reflection) shall not exceed at 0.405μ 30 to 40 per cent, at 0.365μ 12 to 15 per cent, and at 0.313μ 0.5 to 1 per cent.

The measurement of the transmission of infra-red radiation from the sun is usually made by covering a copper-constantan thermocouple with a red glass, such as Jena 4512, and exposing this combination radiometer directly to the sun's rays. As a laboratory source of infra-red radiation, a gas-filled tungsten lamp under normal operation was used. The infra-red transmission of solar radiation was not markedly different from that of the gas-filled tungsten lamp. For the glasses thus far tested, the transmission, including reflection losses, varied from 25 to 35 per cent, which is well below the value set in the original specification.

Since the exclusion of the ultra-violet rays appears to be more important than that of the infra-red rays, it seems desirable to insist upon the exact adherence to the specification for the elimination of the ultra-violet solar rays. It may be added that the glasses tested were of the wired type with one side rough or corrugated. The corrugations or roughness were removed and the surface polished. Measurements were made on areas clear of wire, bubbles and opaque spots. The average transmission of the clear areas but with the corrugations in place would be somewhat lower and the exclusion of ultra-violet would be higher than cited above. However, these values establish a criterion for judging the optical qualities of the glass.

Stern view showing four surface propellers and the two side rudders

Sea Sleds for Passenger Service

TO those of us who have been accustomed to think of the sea sled merely as a means of sport, and as belonging in the same class as the lightly constructed and powerfully engined racing hydroplane, it will come with a shock of surprise to learn that a fleet of sea sleds is being built at West Mystic, Conn., for the maintenance of a high-speed passenger service along a 500-mile stretch of the Magdalena River in Colombia, South America. The official tests of the first of these boats, moreover, have shown that they are capable of carrying 28 passengers at a speed of 34.01 miles per hour, and 65 passengers at a speed of 31.03 miles per hour. The contract called for the accommodation of 20 passengers in a protected forward compartment and the carrying of these passengers and their baggage, or a total weight of 5500 pounds, together with 500 gallons of gasoline, at a speed of 30 miles per hour on a very shallow draft.

Colombia, a country of great wealth, has about 6,500,000 inhabitants, of whom about 5,000,000 live inland at a distance of several hundred miles from the seacoast. There are no railways or passable roads connecting the coast with the inland towns; but the Magdalena River passes across nearly the entire width of the country. The stream is wide and in most places deep; but there are several shoals where it shallows down to a depth of three feet or less. Furthermore, the current of the river is quite rapid. Because of the shallows it is impossible to utilize boats of the ordinary type and speed, and the present transportation is carried on by fleets of stern-wheel river steamers not unlike those on our Mississippi River. By these boats the trip from Barranquilla, the seacoast town, inland to Girardot, a distance of approximately 500 miles, consumes from two to three weeks. The more enterprising Colombians tried out boats of the gliding type, but they proved unable to carry any amount of weight and still maintain their speed; so last year they determined to try the sea sled type, and authorized the Sea Sled Company to build the type of craft which is shown in our illustrations.

The boat has molded dimensions of 47 feet length, and 12 feet beam; its overall length being 50 feet. The construction is exceptionally strong, the scantling being heavy and of oak, and the skin consisting of triple mahogany planking with canvas laid in marine glue between each two layers of planking. The boat is driven by four 200-horsepower motors, each driving its own surface propeller. The pilot house is above the forward compartment and the engine room. The four throttle controls, one to each engine, are mounted on top of the steering column.

Sea sleds in themselves are, of course, not new, for they have been built for the past eight years; but these sleds for Colombia, as developed by Mr. Albert Hickman, have three special features:

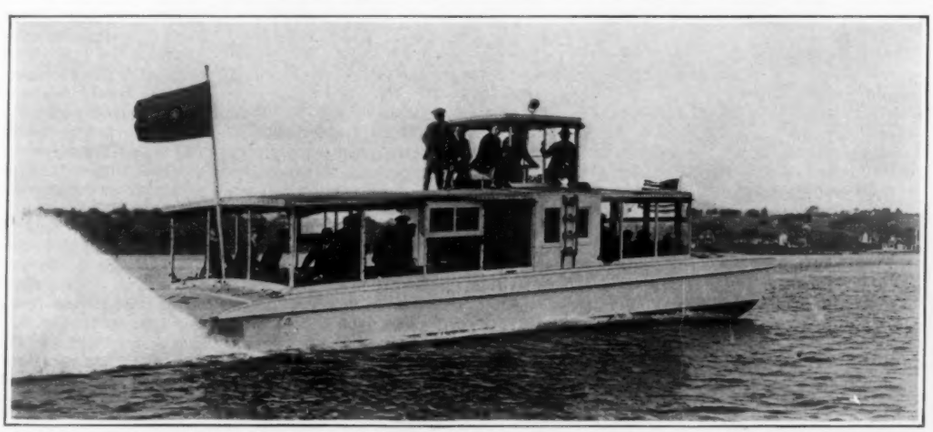
First, there is the shape of the hull itself, which differs radically from other types, since the bottom sections are of the inverted V model rather than of the regular V or round bottom model.

Secondly, the propellers instead of being of the submerged screw propeller type are surface propellers.

Thirdly, the rudders are of the side-plate type.

In the hull itself the inverted V sections permit of no water being displaced sideways as is done in the usual form of boat, and it has proved to be exceptionally seaworthy. The efficiency of the surface propeller arises from the fact that no shafts or struts or propeller bosses are dragged through the water, and only that part of the propellers which is effective in propulsion is submerged. It is also claimed that the side-plate rudders, which are practically an extension of the sides of the boat, also show efficiency over the single, central rudder.

The trial proved that the fuel consumption is remarkably low for the weight that is carried. With a light passenger load, at 30 miles per hour, the total fuel consumption was 69 gallons per hour; and with the weight increased by 41 persons the increased consumption was only 9⅝ gallons.



Built for service on Magdalena River, Colombia, this passenger sea sled has carried 65 passengers at 31.03 miles per hour

The March of Science for 1922

A Year's Developments, as Brought Out at the Annual Meeting of the American Association

FOREMOST among the topics at Cambridge, of course, was the great advance made in atomic physics of recent years. Dr. T. W. Richards of Harvard presented a quantity of photographs of atomic paths and atomic collisions, obtained by photographing an alpha particle, otherwise identifiable as a doubly charged helium nucleus, during flight through damp air. In addition to his discussion of these photographs, some of which presented rather puzzling features, Dr. Richards gave the results of the latest measurements of atoms. The previous values were not affected much, but the new work lends greater precision to their determination.

Isotopes were introduced to the American scientific public by Dr. F. W. Aston, of Cambridge University, England, in his lectures of last spring at Philadelphia, New York, and elsewhere. This is a subject which has not been placed before the lay reader to the extent which it might be, and it is one which we plan to cover in the near future. Dr. R. S. Millikan, of the University of Chicago, was the worker in this field to address the present meeting. To one who had heard the Aston lectures, spreading over five days as they did, there was naturally little new in Millikan's presentation, save perhaps the definiteness with which he states that no laboratory method of separating isotopes for individual study has yet been found. The electric bombardment that separates them for identification does this, and nothing more, and apparently cannot be made to do any more. Dr. Millikan anticipates that if separation and study could be effected, we should find the isotopes of a given element to possess slightly different properties.

It will perhaps be recalled that during the year rather wildcat reports were spread about the work of Wendt and Irion in smashing up atoms by electrical shock. Doubt was expressed that they had done as much as these reports indicated, and certainty was felt that, even if they had, their results were just about what might have been expected, provided their methods were to lead to anything in the way of new results at all. We are no longer startled when told that hydrogen and helium atoms have been detached from those of any other element. It was with iron and other metals that Irion and Wendt worked; and now Dr. Louis Bell tells the A. A. A. S. of similar work with carbon, a certain proportion of the atoms of which broke up into helium groups under the action of high electrical currents.

By Dr. S. A. Mitchell of the University of Virginia, Dr. W. D. Harkins, and others, the probability that we shall find all matter to be ultimately decomposable into hydrogen and helium, with large liberation of energy, was stressed. The apparent identity between mass and energy was brought out in several of the papers in this field; and both directly and indirectly, the invasion of all physics by the quantum theory was recognized.

We shall not repeat here notice of the several papers which Dr. Russell mentions on his page. The connection between atomic physics and the power of the future was brought out by Dr. Frederick L. Hoffman of insurance fame, and Dr. E. E. Slosson, formerly of Columbia. The latter cataloged the possible sources from which power might be developed, naming (1) the internal heat of the earth, (2) the oxidation of minerals and metals in the place where they lie beneath the surface, (3) the tides, (4) solar radiant energy, (5) photo-electric cells, (6) the utilization of differences of electric potential between different points of the earth's surface, (7) the winds, (8) the waves, (9) the sorting out of molecules according to momentum or motion so that the balancing off which now occurs between such motions should be avoided, (10) and finally the internal energy of the atom. The speaker did not seem to have much hope for the practical realization of most of these suggestions.

Dr. S. D. Townley of the Seismological Society of America presented a paper in which it was put forward as a strong possibility that the immediate cause of earthquakes is the action of the sun and moon, whose tidal forces were pictured as giving the final wrench to strained strata. During the discussion of this paper it was brought out that the method of ocean sounding by sound waves reflected from the bottom was being extensively applied in the hydrographic mapping of the Pacific Ocean bottom off California.

Remeasurement of the various stars upon which the Michelson interferometer has been turned has given the same results as originally found, with the single exception of Betelguese. This was found considerably smaller than on the first attack. The star is known to be an irregular variable, and the suggestion is now made that its variability arises from a pulsation in size, between a maximum size equivalent to that of the orbit of Mars and a minimum corresponding to that of the earth's orbit.

President Farrand of Cornell set forth a résumé of what has been accomplished in the domain of public health during 50 years past—that is to say, during the period since it began to be understood that health *was* a public and not a private concern. The average expectancy of life in the United States in that period has been increased from 41 to 56 years. This has been done mainly through the very large elimination of deaths from the ordinary infectious diseases. Naturally enough, this has been accompanied by a rise in the fatalities due to organic disorders—if we never die of germ infection, obviously we must live until we wear out one of our organs to the point where its function can no longer be discharged. Slightly disturbing, however, is the increase in the death rate from diseases like cancer, whose cause has not yet been determined. Dr. Farrand forecasts a possible further lengthening of the average life by 20 years; but this, of course, is going to take much longer than has the 15-year advance already scored. Every year added makes it harder to add the next year to the protracted span of life.

THE annual meeting of the American Association for the Advancement of Science, held during the Christmas holidays at one of the leading universities, is becoming more and more recognized as the annual clearing house of American science, and the place to go to learn what the delvers in pure scientific research have been doing during the year. This year's gathering at Harvard was perhaps the most successful of these conclaves that has ever been held, bringing out about a thousand papers on various subjects. The object of the present article is not to give an exhaustive discussion of any of these—no matter how important; but by means of a very brief account of a considerable number of the subjects presented, to give a cross section of the research of the day.

Dr. H. J. Spinden of Harvard contributed a paper on another aspect of the public health problem. It is perhaps a bit startling to have an anthropologist interested in this subject, but the title of the paper explains that interest—"Malaria in Ancient Greece and Rome." The theory that the degeneration of the Greek civilization was due to malaria is not entirely new, but we have never seen it so completely developed and convincingly set down as by Dr. Spinden. Greece had always had the anopheles mosquito, but had been free from the malaria organism. The latter was introduced by the bringing in of prisoners from abroad, and, of course, ran like wildfire through the native population, lacking resistance through lack of exposure. The result was the very general debilitation of Greek character, Greek arms and Greek civilization which history records but has never before explained. A similar phenomenon was indicated by Dr. Spinden as the cause of the easy conquest of Mexico by the Spaniards. This time it was smallpox that did the trick—a disease to which every European adult of the time was largely immune by virtue of the very fact that he was alive. No doubt our own present civilization would be much racked instead of mildly inconvenienced by new plagues from new lands, such as pellagra and sleeping sickness, were it not for our better ability to strike at the cause.

Continuing deeper into the field of biology, we have to record several papers from the Carnegie Institution of Washington, detailing the results to date in an organized attack by this institution upon the problem of plant chemistry which is presented by the conversion of atmospheric carbon and solar energy into the products needed in the plant's metabolism. A definite attempt is being made to learn how these processes of miniature manufacturing go on, in the hope of being able to imitate them in the making of fuel for our engines. A rather surprising commentary upon the coordination that exists between the modern sciences, when the biologists attack such a problem on such a scale.

Another aspect of materialistic biology was presented by the famous Loeb, of Chicago. Dr. Loeb put forward the rather startling view that the proteids of living bodies are not colloids, but are made up of molecules of gigantic size, less closely associated than is the case with colloids. In fact, according to the speaker, these proteid molecules are of such size and complexity that at the same time they are able to act as bases and acids.

Applied biology of the sort found at the Department of Agriculture and the agricultural colleges was the subject of numerous papers. A very interesting attack upon the wheat rust problem was outlined by Dr. E. B. Mains of Purdue. There are a number of rust strains, and, of course, several hundred wheat strains. It was originally observed that each wheat strain varied in its resistance to the several rusts; and it was hoped, by selecting the individual varieties of wheat showing greatest resistance to the individual rusts, to hybridize a wheat stock that would have high resistance to all the rusts. This proved to be too complex a program; so it was modified, advantage being taken of the fact that in a given section of the country only a few of the rust strains were found. Success appears to be assured in the effort to build up hybrid wheats that can be prescribed for each part of the United States, with high resistance or even immunity to the rusts of that section.

A rather curious feeding experiment was reported by another investigator, in which it appeared that the beetles and other insects that develop in coconnut meal are just as good eating for cattle as the meal itself.

A highly controversial subject was aired when Dr. R. B. Dixon of Harvard stated conclusions formed from the careful measurement of some thousands of Indian skulls of various places and periods. This very method is one which is accepted with varying degrees of reserve by various anthropologists. Nobody knows to just what extent conclusions as to racial origins and affinities may safely be drawn from it. Dr. Dixon regards it as established by his measurements that the American Indians are an extremely heterogeneous race, having negroid strains as well as Caucasian, Mongolian and Australian—all representing ancestors who arrived via Behring Straits and worked their way downward. Dr. Boaz of Columbia, and Dr. Hrdlicka of the Smithsonian, are strongly opposed to drawing such extreme conclusions from the method of skull measurement, though both agree that Dr. Dixon's data are of much value and much significance. The whole question, though one of absorbing interest, is for the present one which must be left to the anthropologists for further threshing out. Later conclusions will be of vital interest.

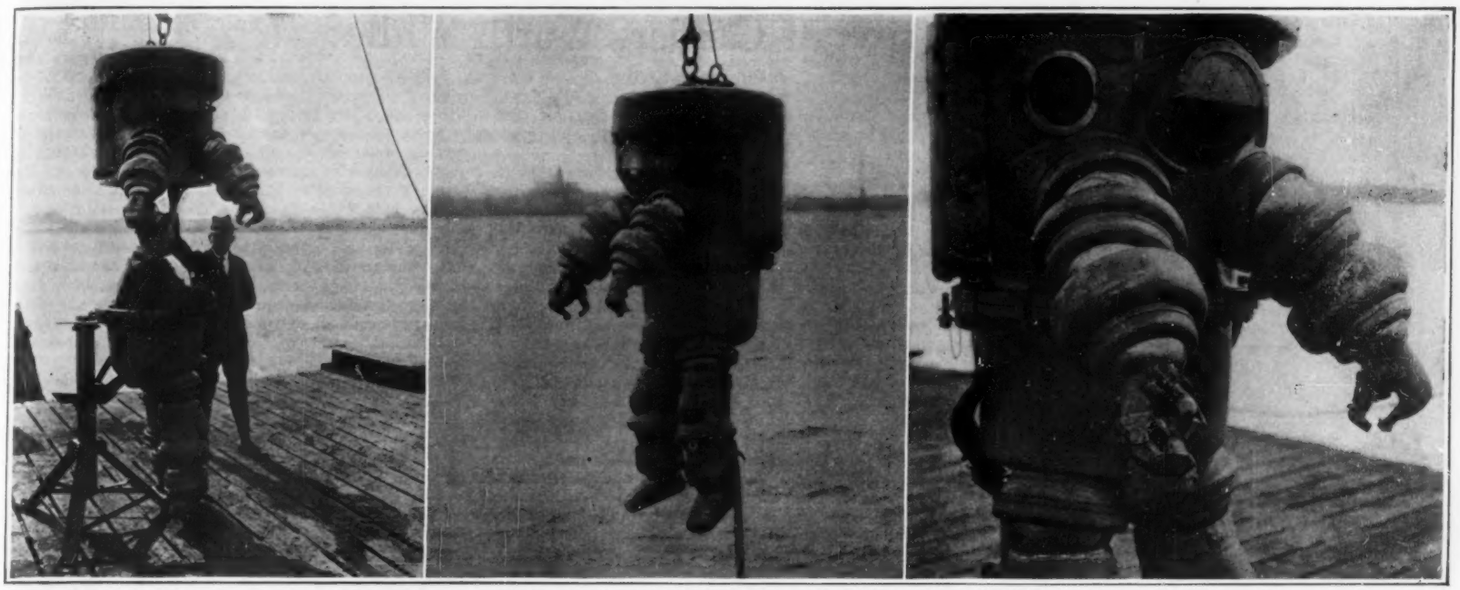
Emissivity of Roofing Materials

THE Bureau of Standards has previously called attention to the question which has arisen concerning the most efficient covering for keeping the inside of a balloon hangar at a minimum temperature when exposed to the sun. The same question also applies to tents and similar structures.

From consideration of the emissive and absorptive properties of substances it appeared that instead of using the roofing material now obtainable, which has (1) both sides covered with asbestos, or (2) both sides covered with a bright metal (aluminum paint) the proper covering is one in which the outside is a good reflector (white paint or asbestos) for short wave lengths and the inside is covered with aluminum paint which reduces the radiation into the building.

These conclusions were verified during the past month when it was found that the radiation from the rear side of an all-asbestos roofing material was reduced by 50 per cent by having the outside of asbestos and the inside painted with aluminum. The temperature rise above the shade temperature was only 15° C. as compared with 25° C. for the sample in which both sides were covered with aluminum.

It seems obvious that tents and other enclosures exposed to the sun can be made more comfortable by painting the inside of the roof with aluminum paint.



Three views of the newest deep-sea diving costume, now being tried out at Kiel, in Germany. This outfit weighs 880 pounds on land, but very little at great depths

A Steel-Ribbed House for the Deep-Sea Diver

FROM time to time we preface an account of a new type of adjustable, universal wrench with the remark that this tool affords the inventor a limitless field, and is in fact one of the standard articles of invention. The universal wrench is not alone in this position; we should think, offhand, that ten articles could be named which would cover 10 per cent of all patent applications. And if this were done, diving apparatus would surely be on the list. The limitations of the conventional diving dress and diving equipment are so very well known, and the sunken wealth to be salvaged by going a few hundred feet farther down than it has even been possible to go is so great that nobody who invents for the love of inventing can remain permanently out of this field.

We illustrate on this month's cover the latest and by all odds one of the most terrifying diving outfits. It is an all-metal suit of extraordinary size and weight, coming in the latter item to no less than 880 pounds. The occupant of such a garment would of course be quite helpless on land, but it is claimed that in the depths for which it is designed, the hydrostatic pressures would be such as to give him considerable freedom. The inventor talks with confidence of working 1000 feet below the surface.

It will be noted that the apparatus is really more a cage than a suit, since the roomy upper section and the head-piece give room for considerable movement within. The diver has with him in his prison an air-chamber subject to his own regulation, electric lights, and a telephone, by means of which he can communicate through the lowering cable with his assistants on the surface. Another remarkable feature is seen in our first view. The suit is such a ponderous affair that it has to be supported on a husky tripod while the diver climbs into it and is bolted up!

While this dress is still in the experimental stage and no useful under-water work has been done with it, the case is otherwise with the sub-aqueous oxy-acetylene cutting torch with which we have asked our accommodating artist to equip his diver. This torch is on the market in several models, the general principle being that of a compressed air blower which holds the water off the immediate location of the flame, giving this a clear atmosphere in which to work. These torches have been described in the SCIENTIFIC AMERICAN of several past issues, notably that of May, 1922.

Photomicrography of Paper Fibers

TECHNOLOGIC Paper No. 217 of the Bureau of Standards has just been issued and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

It deals with the photomicrography of paper fibers and describes some of the more important factors in the photomicrographing of vegetable fibers, especially those used in the paper industry. Suggestions for staining and preparing the material to be photographed are included as well as some data concerning the value of photographs for permanent records and as a means of studying and controlling materials and mill processes.

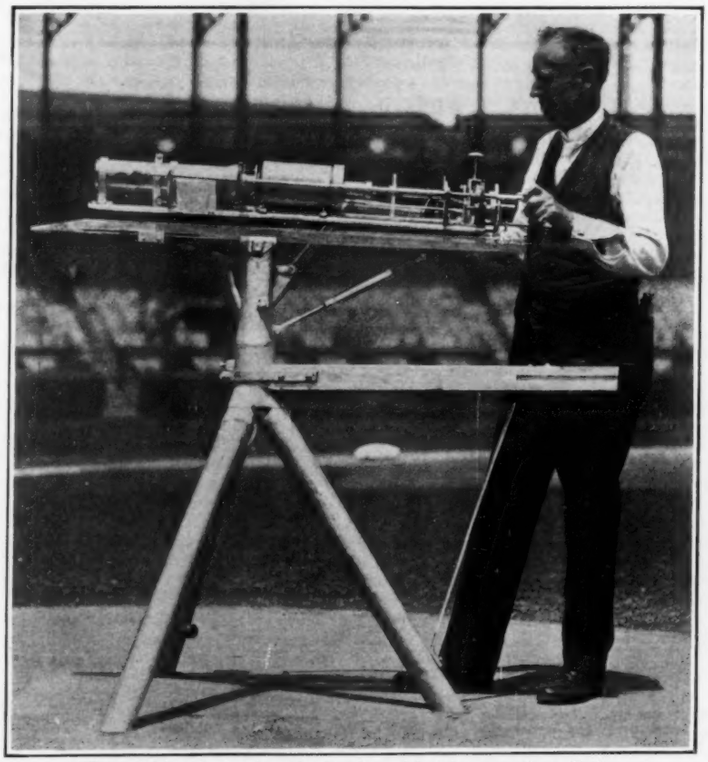
These columns have contained, in the past, quite a little matter on photomicrography, much of the material being from Leon Hausman, research zoölogist and microscopist, Rutgers College.

The Mechanical Pitcher

THE art of the pitcher is the one feature of our national game that seems to offer scope for mechanical ingenuity. If, by clever manipulation of thumbs and fingers over the surface of the ball, the human hand is able to impart a spin that causes the sphere to indulge in sudden jerks and darts, how much more could it not be induced to depart from the true parabola of its trajectory if the erratic impulse came from mechanical fingers of steel and rubber? More than one inventor has had this idea, and more than one inventor has worked it out.

Such machines, of course, are not intended for use in the actual nine-inning combat between rival teams. Their utility for batting practice, however, is very real. The great trouble with batting practice is that the pitching is not the real article. No pitcher can possibly work in this two-hour session as he does in the game; not even when he is carried on the payroll for the sole purpose of practice work. But the machine is never tired. Moreover, the machine can deliver speed and curves of such extreme character that the man who habitually faces it in practice finds that regular pitching is actually easier than that served up to him in the morning, rather than harder.

With all this, however, pitching machines have never come into general use. Mr. B. L. Blair says that he knows why this is; that no machine has ever been devised that acts like a pitcher. So he has set to work to remedy the deficiency, and has come out with an apparatus that is of such novel design as to have been granted patent protection not alone as a sporting accessory, but in the role of a grenade thrower.



The machine that takes the burden of batting practice off the pitcher's shoulders

Mr. Blair says that the way to make a ball curve is to make it twist; and that if we are going to make it twist, it is perfectly foolish to confine our impulse to the mere use of mechanical fingers. So he provides a whirling jet of air that goes with the ball for a considerable distance through the short barrel of his pitcher; and when the ball emerges from that barrel, it is spinning with a sharpness and at an angle unequaled by anything produced by finger or previous machine. The device was given a try-out at the Polo Grounds in New York last year, by both of New York's major league ball clubs, and found favor with both managers. And one of the Pacific Coast clubs has actually adopted it for regular use, and with the result that the batting averages of the entire club against regular pitching in the league games were materially fattened.

This same automatic pitcher should have a real military value. During the World War the rôle of the hand grenade, particularly in trench warfare, was clearly illustrated. Since considerable dexterity is required in the throwing of hand grenades with a fair degree of accuracy, various grenade throwers, operated by compressed air, were introduced. The present pitching machine seems admirably adapted to grenade throwing and possibly it may yet have a sinister task to perform, aside from sport.

Are Huge Aircraft Carriers Worth While?

By Hector C. Bywater

THE description published in this journal dated December last, of the changes made in the design of the battle cruisers "Lexington" and "Saratoga" to equip them for their new rôle as aircraft carriers, raises anew a question which has been discussed in British naval circles for some time past, namely, whether it is sound policy to employ as floating airdromes vessels of very large dimensions. As the arguments against this policy certainly appear to deserve consideration, it may be worth while to summarize them here.

(1) Huge aircraft carriers are to be deprecated on economical grounds. As each unit costs a great deal of money, the total number of such vessels must in any case be limited, irrespective of the restriction imposed by the Washington agreement. Would it not be better to build three medium or four comparatively small carriers in place of two very large ones? For the cost of building one "Lexington" it would, no doubt, be possible to build two ships of the British "Hermes" type, 10,950 tons. Moreover, to concentrate practically one-half of the aviation material of the fleet into one ship is to put "all the eggs in one basket," and a somewhat fragile basket at that. A ship cannot be in more than one place at a time, and it is not difficult to visualize occasions when the possession of one or two additional aircraft carriers would make all the difference between success and failure in executing some problem of strategy or tactics. Another fact to be remembered is that the enemy would naturally make a determined attempt to destroy or disable these huge floating airdromes, knowing that the loss of one would be a terrible blow to the other side by depriving it of half its air force and thus rendering it partially blind. For this reason such ships would become the target for concentrated attack by submarines, aircraft and other weapons.

(2) The aircraft carrier is exceedingly vulnerable, in that superficial injury which would not impair the fighting power of an ordinary battleship or cruiser might put the carrier out of action. If the flying-off deck were holed by bombs or bursting shell, even of small caliber, machines could no longer alight on it, and the power to do this is the chief justification for building very large carriers. The spacious deck of the "Lexington," for instance, would present an inviting mark for bombing airplanes and long-range gunfire, and one direct hit might tear a huge gap in the light plating, making it a death trap to descending machines. The recent experiments with the British battleship "Agamemnon," which was bombed from the air when steaming at 15 knots under radio control, showed that a good percentage of hits can be reckoned with even when the attacking planes keep at a great height. The "Lexington" would, of course, offer a target nearly four times as large, and in time of war attacking planes will take big risks in order to get their bombs fairly on the mark.

(3) The only advantage the "Lexington" has over the "Hermes," a ship of two-thirds less displacement, is her ability to act as a landing ground for homing airplanes and her greater capacity for housing planes; but the first advantage might be nullified by a lucky hit in the opening engagement of the war, while if the ship were sunk the loss of aviation material would be proportionately greater. In any case, many naval officers regard it as unnecessary to make special provision for the landing on deck of airplanes after flight. This is no easy performance under the most favorable conditions prevailing in peace; it would be infinitely harder to accomplish under the conditions of battle, with the carrier probably steaming at full speed, making frequent changes of course, perhaps under a heavy fire, and half obscured by shell splashes and powder fumes. The probability is, therefore, that in time of war an airplane which had once left the carrier could not return to it, and must either be abandoned or left in the water until an opportunity occurred for salving it. If this view be accepted, the principal argument in favor of huge floating airdromes ceases to have any point, for airplanes can be launched with ease and safety from ships of relatively small dimensions, as has been proved in actual practice.

The British Navy has two big aircraft carriers: the "Eagle," an ex-battleship of 22,790 tons; and the "Furious," ex-battle cruiser, of 19,100 tons. But its most successful carrier is the "Argus," of 14,450 tons, and it is significant that in the "Hermes," the first ship *specially designed* for this purpose, and not converted as the others were, the Admiralty did not go above 10,950 tons. The impression in Europe is that the former American and Japanese battle cruisers are being transformed into aircraft carriers less on account of their inherent fitness for this work than because it furnished a means of saving these valuable ships from the junkpile and adding floating airdromes to the respective navies more quickly than would have been possible if entirely new ships had to be designed. Probably, also, it was easier to obtain appropriations for converting the half-finished ships in question than for new construction.

Nicotine in Your Tobacco and Tobacco Smoke

TOBACCO contains nicotine. There is no doubt about this at all, and the tobacco-user would not have it otherwise, for a nicotine-less tobacco would have about the same effect as beer with the alcohol removed. The stimulation that is derived from the smoking of tobacco is due to the nicotine that it contains. Of course, the proportion of this alkaloid in tobacco varies greatly with different kinds of tobacco and also in accordance with the methods used in its cultivation. But, after all, what is most important is the percentage of nicotine in the tobacco smoke, for that is what comes in contact with the tissues of the mouth, throat and lungs.

There are many different kinds of tobacco, not only as far as grade is concerned, but also in regard to the particular species of the genus, tobacco. There are about forty different kinds of tobacco plants and practically an innumerable number of grades according to the cure taken in the cultivation and in the subsequent curing and sweating treatments. There are in fact but few plants that are so susceptible to soil, feeding and culture, as tobacco. Its cultivation requires exact scientific knowledge and the changes that take place in it during curing are just beginning to be properly understood and appreciated. These changes can be properly controlled so as to secure the best results. Similarly, the proper selection of conditions under which the tobacco plant is cultivated has an important effect on the quality of the product.

Both in the cultivation of the tobacco plant and in the after-curing of the tobacco leaves, it is possible to exert a certain control over the percentage of nicotine that is contained in the product. Nicotine is an alkaloid. It belongs to that important class of organic substances which are particularly characterized by their extremely potent physiological properties. They are all very deadly poisons and generally of great utility to the physician. Such substances as morphine, cocaine, heroin, strychnine, caffeine are alkaloids. Nicotine can accordingly exert a powerful action on the human system; in fact, it is a deadly poison, almost as poisonous as prussic acid gas. Nicotine, itself, is used on rare occasions in medicine as an antidote in strychnine poisoning, and in the treatment of the disease, tetanus.

Nicotine contains the element nitrogen. Accordingly, tobacco that is grown in a very rich soil, which has been fertilized with a strong nitrogeneous manure, will be high in nicotine. Tobacco, grown on a sandy loam soil, containing but little organic matter, will not be high in nicotine. That is the reason why certain Havana tobaccos contain so little nicotine. Furthermore, climatic conditions, the treatment of the crop, the number of plants grown within a given area, the humidity in the atmosphere and other conditions are sure to affect the percentage of nicotine in the tobacco leaves.

Similarly, the curing and sweating treatment has a very potent effect on the amount of nicotine in the tobacco. Curing tobacco consists in drying it, either by the natural action of the air or by artificial heat. Sometimes the smoke, produced by burning sassafras or hickory wood, is used for this purpose. After the tobacco has been dried, it is then moistened, the temperature is allowed to rise and the tobacco is said to sweat or ferment. Just exactly what happens during sweating is not known, but the tobacco attains thereby its rich, familiar, brown color. Bacteria undoubtedly assist in the action. Certain objectionable ingredients are broken down, ammonia being liberated quite freely and excess nicotine being eliminated.

Tobacco, just like every vegetable substance, contains a variety of ingredients. Besides nicotine, there are resins and fats, starch, glucose, mineral matter, etc., in the tobacco leaf. Some of these substances are essential in giving tobacco its flavor, in fact their varying proportions characterizing the various qualities of tobacco. Not all of the ingredients that are found in the green tobacco are detected in the cured tobacco, as decomposition ensues during the process, resulting in the breaking down of various constituents. However, of all these there is none as important as nicotine, for it is due to that substance that tobacco possesses its peculiar physiological action on the human organism.

Consequently, the percentage of nicotine in tobacco is an important consideration. It determines the potency of the tobacco, but contrary to what might be expected, it is not what determines the quality of the tobacco. Rather the contrary. Tobacco containing high percentages of nicotine is apt to be coarse and of relatively poor quality. The finer grades of tobacco contain less nicotine. In general, it may be said that the average percentage of nicotine in tobacco leaf varies between 2 and 3 per cent. There are, of course, tobaccos which contain more or less nicotine than this. For example, the nicotine in a fine grade of Havana, used for making cigars, amounted to 0.64 per cent, while that in another grade of Havana ran as high as 3.98 per cent. A Manila tobacco averaged 3 per cent of nicotine, while German tobacco ran around 3.42 per cent, Java around 3.30 per cent and Chinese tobacco around 2.50 per cent. The average smoking mixture runs about 2.85 per cent nicotine, but many ingredients, used therein, are either much lower or much higher in nicotine content. For example, Perique tobacco, which is very strong and hardly ever smoked straight, contains 5.30 per cent of nicotine. Latakia, another ingredient of smoking tobacco, varies from 1.17 to 2.35 per cent of nicotine. Virginia tobacco varies from 1.40 to 3.86 per cent nicotine; Kentucky tobacco contains on the average 4.59 per cent nicotine. Some Turkish tobacco runs as low as 0.90 per cent of nicotine, while others run as high as 1.38 per cent. One sample of Egyptian tobacco gave 1.74 per cent nicotine. A very strong chewing tobacco has been known to contain as high as 6 per cent nicotine. In no case should these figures be considered as absolute, for there may be samples of tobacco that will vary greatly from the average in their nicotine content. There are many variable conditions, both in the cultivation and the after-treatment of the tobacco, that possess too great an influence on the proportion of nicotine in the tobacco, to enable any definite figure to be set for any one kind of tobacco.

How much of the nicotine in tobacco passes into the smoke? This has been a much-mooted question, and is still open to argument, due to the fact, viz., that there has been no absolutely and universally accepted accurate method for the chemical determination of nicotine. Some investigators have claimed that as much as 75 per cent of the nicotine in the tobacco is present in the tobacco smoke; others have held that only 25 per cent remained intact after the burning process.

It is evident that tobacco, being organic matter, will burn. So will nicotine. If it burns up completely, then the smoke will contain no nicotine at all. But that is not possible. There is undoubtedly some nicotine present in tobacco smoke, and the probabilities are that this percentage is closer to 25 per cent than to 75 per cent of the original amount in the tobacco. The rest of the nicotine is burned up, being converted into other products, which are also possessed of powerful physiological effects on the human body. It is interesting to note that the nicotine that is obtained in the smoke from a cigar of ordinary size, made from tobacco containing only 2 per cent of nicotine, on the basis that only 25 per cent of such nicotine is present in the tobacco smoke, is equal to more than four times the minimum fatal dose of the alkaloid, taken internally. It is accordingly evident that the nicotine in the state of smoke, drawn into the mouth, has an entirely different effect than when it is taken internally.

The smoke from burning tobacco has been analyzed and various other ingredients has been found to exist in it. Some of these ingredients are highly poisonous, but they are present in such small amounts that they are not able to produce any injurious effects in the short time that they are present in the mouth and the passages of the throat. It is very likely that some of these ingredients of the tobacco smoke are responsible in part for its physiological action.

It is quite evident that the way in which tobacco is burnt will have a great influence on the amount of

(*Continued on page 215*)

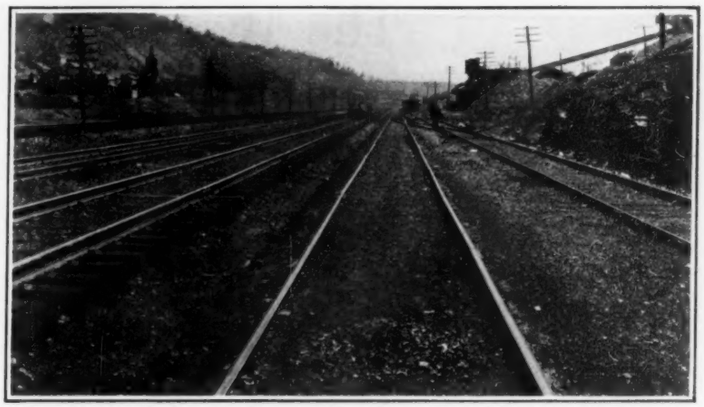
Cleaning Railroad Track With a Power-Driven Sweeper

AMONG the special appliances which have been developed for the maintenance of railroad track by the substitution of mechanical for hand labor, is a power-driven track sweeper which is now in successful use on the Pittsburgh Division of the Central Region of the Pennsylvania Railroad. This unit sweeps up and loads into cars the accumulated dirt—chiefly ashes, cinders and coal dust—which rapidly fouls the track and ballast in the mountain sections of the road where pusher locomotives are used. The traffic here is heavy and in climbing the grades the locomotives necessarily are worked at high pressure. The heavy exhaust from the smokestack throws out into the atmosphere a certain amount of fine material which falls on the tracks; coal is shaken from the tenders or from coal cars, and there is a gradual accumulation of material that is necessarily inseparable from the operation of lines over which a very heavy traffic is carried. The power-driven sweeper has proved to be a great success; it operates at an average speed of about four miles an hour, and as will be seen from the two accompanying photographs, one taken before and the other after the passage of the sweeper, the track is thoroughly cleaned. Not only does the new device do a good job, but the tests to date have shown that the cost of sweeping is approximately one-half of what it normally would be if done with hand-labor.

The sweeper is used chiefly on the pusher grades of the Pennsylvania main line through the Allegheny Mountains; that is to say, on the westbound tracks from Altoona, Pa., to Gallitzin, and on the eastbound tracks from Johnstown, Pa., to Gallitzin. It is used also for cleaning up the sidings and yard sections. As we have said, the dirt accumulates quickly on this part of the line; and there are about 102 miles of track that require cleaning from four to six times every year. Primarily, this cleaning up is necessary to keep the signals working properly; also to maintain the track in such condition that a proper inspection of the rail fastenings can be made periodically, and to prevent the ballast from becoming badly fouled.

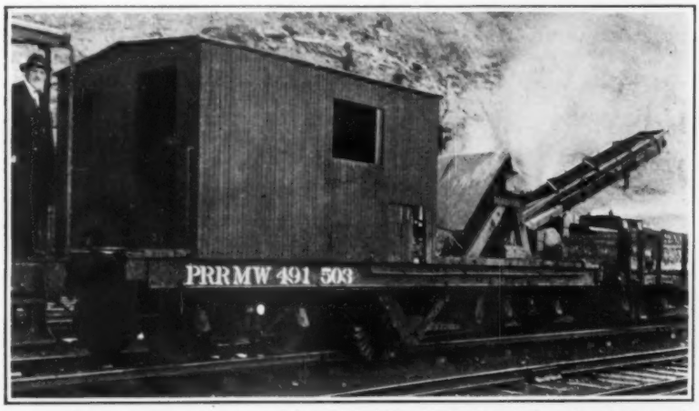
The sweeper consists, essentially, of a rotary steel broom, built up from steel splints one-thirty-second inch in thickness and three-sixteenth inch in width. The broom, which is three feet in diameter and seven feet long, is so suspended under the frame of an old flat car by special hangers, that it may be raised or lowered as desired. This is done through the use of an airbrake cylinder connected with the train airline. The broom turns at about 100 r.p.m., and it is driven from a gasoline engine mounted on the deck of the car. A steel pan, hinged and shaped so as to fall over the two rails, is attached slightly ahead of the rotary broom, which sweeps the accumulations up this pan on to a conveyor belt seven feet wide. This belt runs over two rollers spaced eight feet nine inches center to center, and it is chain-driven. The dirt and ashes are retained on the belt by two-inch angles riveted across the full width of the belt and spaced one foot eight inches apart.

The debris which has been lifted by the belt is discharged into a hopper, which in turn discharges it upon another conveyor belt, that is mounted on an extension boom, which runs over rollers spaced twenty-four feet two inches center to center. This arrangement, which is shown clearly in one of our illustrations, permits the final discharge of the swept-up material at a convenient distance from one end of a hopper gondola, or other type of open-top car, coupled next to the sweeper. In order to secure maximum results in operation, the entire arrangement is housed over for protection from the weather. The sweeper and car for reception of the dirt are operated by one of the smaller types of engine in service; since but little power is required. The work is generally performed under traffic, and particularly good results are obtained with the device after a light rain has fallen; for the moisture serves to bind the loose material and ensures that the whole of it will be swept up on to the belt.



Stretch of track showing ties covered with an accumulation of ashes, cinders and coal dust

The same stretch of track after the passage of the sweeper, showing ties and rail fastenings clear of debris



Power-driven sweeper, designed by Pennsylvania Railroad for cleaning track on the mountain section of its lines

Root Respiration

ALTHOUGH so much work has been done on the question of root respiration, it is only within the last few years that the importance of the air content of the soil in this connection has been clearly demonstrated. With the growth of ecological work has come the indication that this air content is a primary factor in many habitats and a controlling one in wet soil and water; but even yet this is not generally recognized.

The composition of the soil varies considerably with the nature of the soil, time of year, and seasonal changes, and is also affected by cultivation and plant growth, which increase the carbon-dioxide and diminish the oxygen in proportion. It has been suggested by Bristol that the presence of algae may also affect the soil gases.

Anaerobic respiration is of much significance in connection with reduced oxygen supply. The general effect of the reduction or absence of oxygen on respiration is to reduce its intensity, but respiration under anaerobic conditions differs with the species. Carbon-dioxide and alcohol are the regular products of such respiration, which is consequently regarded by most investigators as essentially identical with alcoholic fermentation when carbohydrates are present. Under certain conditions acetic, formic, and lactic acids are excreted from the roots and other parts of flowering plants. Growth is decreased or prevented by the absence of oxygen. The movement of protoplasm in plant cells is stopped and practically all tropistic responses are suppressed.

Field studies of aeration, approached from the agricultural, pathological, and ecological standpoints, corroborate the results of physiological investigation as to the basic importance of oxygen for root activity and the injury wrought by the accumulation of carbon-dioxide. The practical importance of this appears most strikingly in irrigated regions where the common practice involves the use of too much water, with consequent economic loss, due to the production of an oxygen deficit in the soil.

The problem of soil aeration and the way in which it works injury to plants is much under discussion, but it appears certain that in some soils the lack of oxygen and the accumulation of carbon-dioxide are primary factors, while the organic acids and salts arising from anaerobiosis may play some part. In other cases acidity brings salts of aluminum, iron, or manganese into solution, which then exert a toxic effect.—*Abstract from Nature, August* 8, 1922.

The Efficiency of Man

IN a recent presidential address before the British Association for the Advancement of Science Professor Cathcart discussed the efficiency of man and the factors which influence it. Professor Cathcart, after a brief discussion of the meaning of the term efficiency, in which he differentiated mechanical and industrial efficiency, went on to emphasize the intimate relation which exists between the efficiency of man in the physiological and industrial sense. There was a tendency to lay too much stress on organization and machinery; to forget the fact that no matter what mechanical improvements were evolved man was always behind the machine, and that, therefore, physiological laws must be reckoned with as an essential factor in industrialism. Attention was directed to the very large annual loss in time due to sickness and disability, and it was pointed out that primarily this wastage could not be charged to man being of unsuitable design for the work he was called upon to perform; on the contrary, the physiological balance of the organism was beautifully designed to meet most varying strains. After reference to the relation of the various systems, respiratory, circulatory, etc., to the maintenance of efficiency, Professor Cathcart went on to discuss the factors which, in his opinion, play the predominant rôles in the maintenance of maximum efficiency. He believed that there were, at least, four intrinsic factors, *i. e.*, factors directly related to muscle movement—(a) the rate of the performance of the work, (b) the amount of rest offered to or taken by the subject, (c) the rhythm with which the work was performed, and (d) the work habits developed by the worker. He reviewed each of these factors in turn; the influence of load and the type of work (positive and static) was dealt with under the rate of performance, and the formation of conditioned reflexes in connection with rhythm and habit. The more intrinsic factors, *i. e.*, those less directly related to muscle effort, were next discussed, including the influence of the state of nutrition and the nature of the food supplied, of the work environment, and the psychic factor generally, particular reference being made to monotony of occupation and the part played by the temperament of the worker. Other still more intrinsic factors like housing, personal habits, lighting, heating, ventilation, etc., were also mentioned.

The Mysteries of the Modern Organ

The Things the Organist Has to Do, and the Ways He Has to Do Them

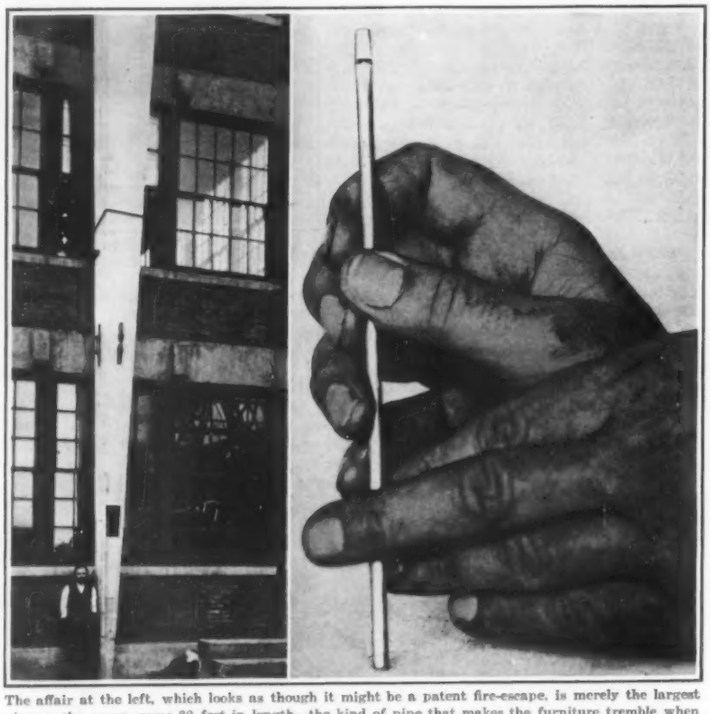
By R. P. Crawford

THE MODERN pipe organ, which now graces theaters and concert halls, as well as churches, is practically an unknown instrument as far as most people are concerned. There has been no instrument which has shown such marvelous mechanical development the last few years as has the organ. Whereas a few years ago an organ costing $50,000 was a decidedly unusual instrument, today there are many being installed in auditoriums and theaters costing that amount. In private homes organs costing $5,000 to $30,000, and even beyond, are finding a place, to be played by means of rolls of music like a player piano.

There are a number of organs in the United States today which surpass even the greatest cathedral organs of the Old World, and when it comes to mechanical improvements the United States is far in the lead. To the average person who goes to church or to a theater it seems a sort of magic to see an organ split up into four or five different parts, perhaps being placed on both sides of the stage, with another section in the back of the auditorium, and perhaps another organ hidden away in the tower if it be a church, or in the roof if it be a theater. And yet the whole is played from a keyboard that is perhaps a hundred or two hundred feet away, and responds instantly to the slightest pressure on the keys. All that a person sees connecting the organ and this keydesk or console is a tiny cable, and the keyboard can often be moved around like any other piece of furniture. And, in fact, this little cable is all that does connect the organ and the console.

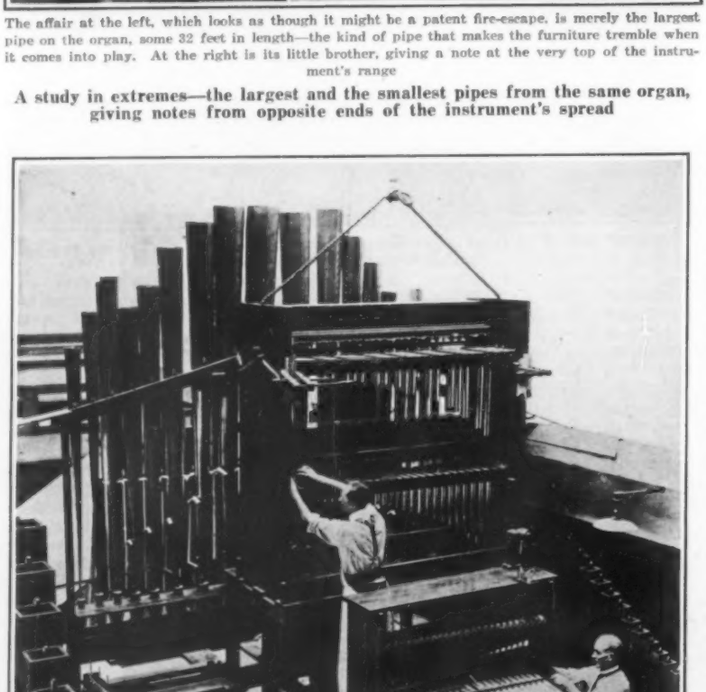
How is it all done? This is where the inventive genius of the last few years has played its part. Electricity which has played such a big part in all lines has also come to the rescue of the organ. Perhaps you remember how playing the pipe organ in the church back home used to be considered almost a man's job. It took every ounce of strength one could muster to depress the keys when playing on the full organ. That was because all of the actual work of opening and closing the pipes was done with the fingers. And when one had to open some 60 or 70 pipes with the strength of one hand, it was all one could do. But today an organist can play an organ six or eight times as large as the old church organ, and the keys are often so sensitive to the slightest pressure that a breath of air is almost sufficient to move them. Electricity has made possible the dividing of organs and the instantaneous response of the different pipes to the pressure of the fingers.

That little cable running from the keyboard to the organ holds the secret. In that cable is a wire from every key and from every stop and mechanical accessory on the keyboard. This cable goes to a relay box. Here the proper connections are made and tiny currents of electricity transmits to the pipes their impulses. If certain stops, representing individual instruments of the orchestra, are drawn, and certain keys are depressed, this relay box makes the electrical connections so that every pipe which is affected by both those particular stops and those keys is brought into instant response. The relay box is the "Hello Central" of the organ. Practically every organ today has its own dynamo which generates electricity of a very low voltage for operating this system of tiny telegraphs. An organ may contain many miles of wire in all of these magnets and electrical connections.



The affair at the left, which looks as though it might be a patent fire-escape, is merely the largest pipe on the organ, some 32 feet in length—the kind of pipe that makes the furniture tremble when it comes into play. At the right is its little brother, giving a note at the very top of the instrument's range

A study in extremes—the largest and the smallest pipes from the same organ, giving notes from opposite ends of the instrument's spread



The man above is adjusting the "chimes," the man below, the "harp." As will be seen, the organ achieves these (and many other) effects by substitution, producing by other means the sound that is customarily identified with the instrument whose name it carries

Chimes that are not chimes, and a harp that isn't a harp

The last few years have also witnessed the development of an entirely different tone for the modern organ. The old organ tone now has an added orchestral quality. This does not mean that simply drums and harps and chimes have been added to the modern organ, but even many of the old tones have changed a great deal. To judge this for yourself, go into one of the old churches, one where the organ was installed many years ago and has never been rebuilt, and then hear a modern theater or church organ, and this difference in quality of tone will be most apparent. The modern organ imitates very well the strings of the orchestra. Some of the pipes of the organ have today been made to resemble this string tone so well that in one case at least an expert could not tell the difference between the real instrument when sounded and the tone from the organ pipe. It has been a long jump from the rather crude imitations of the orchestral instruments offered by organs some years ago.

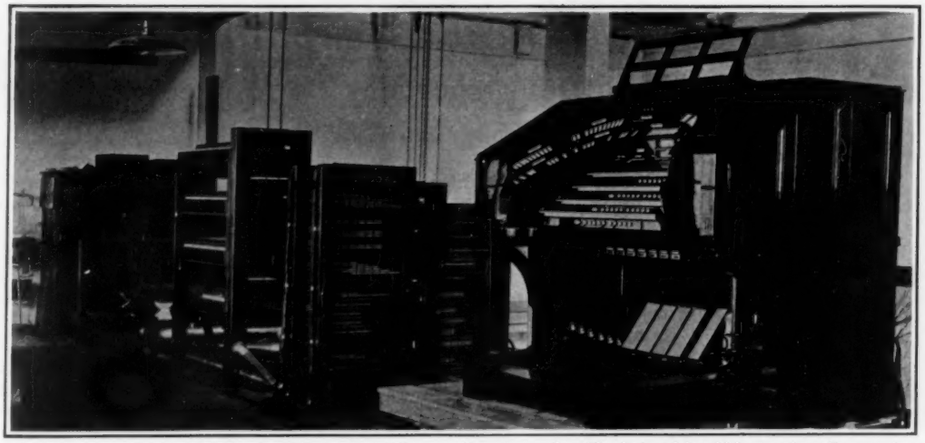
Percussion instruments such as drums and chimes have been added to the modern organ. The more outstanding of these percussion effects are to be found of course in theater organs where every effect from sleighbells to the clack of horses' hoofs is at the command of the organist. Even church organs have chimes and harps, the chimes being long metal tubes, and the harp in practice not being a harp at all, but consisting of metal or wood plates placed over resonators and struck by padded hammers. Many large organs today have grand pianos which are played from the keyboard.

Everything is left to the ingenuity of the organ builder. Organs for the most part are not kept in stock but every organ is built to fit the building in which it is to be placed. Many organs are being installed in private residences and one builder told me how in some cases he had had to place the organ in the old butler's pantry, or up on the third floor, or in the basement, and arrange for a shaft to carry the music to the main floor. The same problems are met with in churches and theaters, and various methods have to be resorted to in order to carry the sound. Sound deflectors are often used to focus the sound from certain parts of a large organ, and there may be openings in the floor or ceiling through which part of the music is carried. The largest organ pipes generally used are those 32 feet in length, representing the deep bass tones, and it is often a problem to find a place to put these large pipes. In the case of most theater and residence organs, and in some church organs, the organ itself does not show, being concealed behind a grill or screen.

But the real job is left for the organist himself. Most people do not know that an organist actually plays with his feet, some imagining that organ pedals are like those on cabinet organs. However, no organist pumps his own wind, since a large organ may require electric motors with more than 100 horsepower to supply sufficient wind. There is a row of pedals along the base of the console, which are actually played with the feet, representing the deep bass notes, about half as many keys being found here as on one of the rows of keys played with the hands. The

short pedals are sharps and flats.

The organist must learn to think in terms of his feet as well as his hands, while the pianist has only his hands to bother with. In addition, the organist has often a hundred or so stops, or individual instruments, which are represented by little tablets or knobs on the keyboard. Then there are buttons and levers to be pushed with hands or feet, which control certain groups of these stops. In addition, there are usually four banks of keys on a large organ, each of these representing a division of the organ, with its own stops and own peculiar quality of tone. Then there are couplers which couple these different banks of keys, one to the other, and a few extra pedals which regulate the volume of tone by opening or closing the shutters to a box in which part of the organ is usually enclosed. Assuredly the organist must keep his head—and use it, too—with such an instrument.



At the left are the relay boxes, where all the electrical connections are made. The foot pedals which operate ordinary notes of the organ are seen, and above and behind them the broad, flat pedals that control the gradations of sound from the organ. The tablets and buttons above and between the rows of keys are stops and combinations representing different orchestral instruments, or combinations of these

The keyboard or console of the modern organ

When Electricity Magnifies the Speaker's Voice

THE ordinary telephone receiver such as is used on our present-day telephone lines operates on the electromagnetic principle. The voice current passes through a winding on a permanent magnet, changing its flux intensity and consequently its pull on a diaphragm placed directly over the pole ends. Its weakness lies in the fact that if the diaphragm is placed at a distance away from the pole pieces the magnetic influence is greatly lessened, and if placed too close the diaphragm hits the poles. A compromise position is selected whereby the diaphragm is placed at a distance from the poles that allows it some motion before hitting the poles, and yet near enough to get a fair magnetic pull. Another weakness is that the diaphragm is under tension always and has to be made stiff to withstand this tension. All types of receivers using the electromagnetic principle will give forth sound only up to a certain point and then the diaphragm will hit the poles.

In 1911 two inventors, E. S. Pridham and P. L. Jensen, were actively affiliated with the development of arc radio transmission and reception at Napa, California. During the course of the work, they made a very exhaustive study of various methods for the reception of rapid radio signals. Naturally enough, the development of what is known as the string galvanometer was carried out, and it was while conducting these experiments that several new and improved receiving devices were built. Among them was the first step in the development of the electro-dynamic receiver, now well known for its loud-speaking characteristics. It is the electro-dynamic receiver which is employed in radio reception so that music and signals can be heard throughout a room, and the same device is employed in amplifying a speaker's voice so that he can address a crowd running into the tens of thousands.

This early type was built along the lines of a modern voltmeter, with a revolving coil in a magnetic field attached by lever action to a diaphragm. This, however, was not a success as a telephone receiver, and while it did reproduce the voice with remarkable distinctness, it was not nearly loud enough, or even as loud as the ordinary electromagnetic type. While this instrument was not important in itself it was to be taken into consideration as the forerunner of the practical electrodynamic reproducer of today.

After many experiments with the revolving coil, the idea was definitely given up and a new line of experiments started. The next instrument developed was the true electrodynamic loud speaker or receiver, although it was not known at that time that it had loud-speaking characteristics. Two very large electromagnetic structures were made, and a small coil of fine wire wound on mica about three inches long by one inch wide, and very flat and thin, was also introduced. This coil was suspended in the air gap of the two electromagnets, rigidly attached to a diaphragm. The coil was located in such a way that both the three-inch sides of the flat coil were in a strong magnetic field of the proper polarity when the magnets were energized. Both sides of the diaphragm were enclosed and ear tubes led out, one side for each ear. The total weight of the receiver was about 60 pounds.

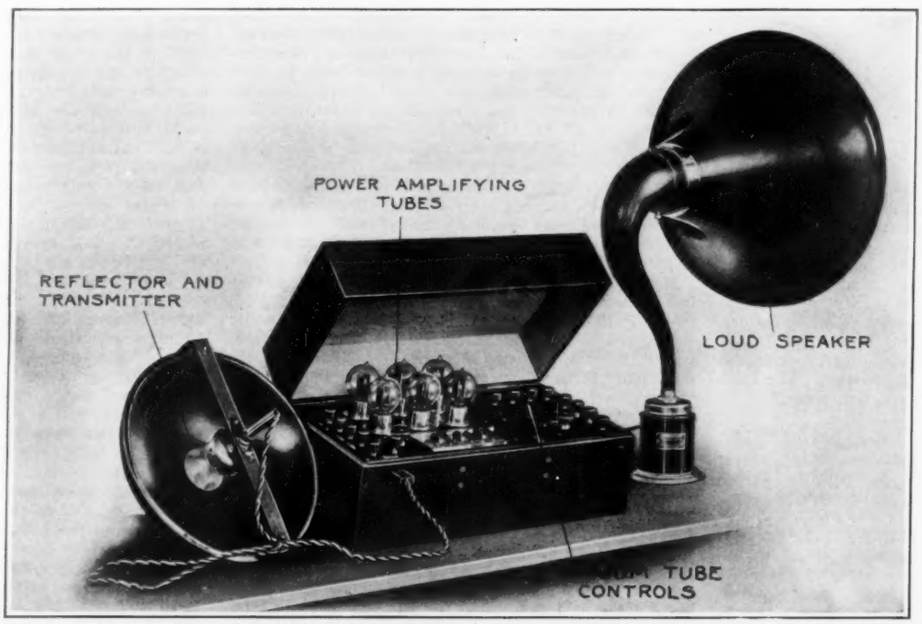
At once it was found that this new receiver had different internal characteristics than the electromagnetic type of reproducer. In spite of the great weight of movable parts attached to the diaphragm, about two ounces for the movable coil, it was found that the new instrument gave better speech reproduction from weak impulses than the ordinary receiver. Overtones were held, consonants and sibilant sounds were reproduced perfectly; in short, the quality of the speech was a revelation. But in spite of the fact that this instrument responded to impulses weaker than those necessary to affect the electromagnetic type of receiver, its loud-speaking qualities were still undiscovered; in fact, they were not yet developed in this particular instrument.

A number of experiments were performed with this instrument which were at that time nothing short of remarkable. The two inventors realized that there were great possibilities in the principle and proceeded to try out the new type against existing telephones. On a trip through the East in August, 1913, one of the inventors remained in Denver, Colorado, while the other proceeded to New York City. Arrangements were then made to get a through telephone connection from New York to Denver. Such arrangements, however, were not favored by the telephone companies as articulate speech was not possible over that distance of straight wire. It must be remembered that this was before the day of vacuum tube repeaters and that line conditions were very bad over long distances. After three days the connection was made, and although the inventors were warned by the telephone companies that they would not be able to understand each other, very satisfactory speech was carried on using the electrodynamic telephone. At the same time, nothing could be understood over the receiver as ordinarily used. This test proved to the inventors that their device had merit, and that the next problem was so to condense and redesign their receiver that it would be commercially practical, for complete it weighed 60 pounds.

This original receiver had a moving coil wound to 70 ohms resistance, so that it might be interchanged with the ordinary 70-ohm magnetic receiver. This amount of wire, however, was one of the things which made up the weight of the moving parts, and in order that these moving parts might be made as light as possible, the moving coil was cut down to 20 ohms resistance and a proper induction coil supplied to fit it. The coils were still wound flat on a mica sheet, but in order to reduce still further the weight of the complete instrument, one of the electromagnets was done away with and the little coil was found to function perfectly with only one side of the coil in the magnetic field. This type was finally developed, and was the first of the electrodynamic receivers to be commercially successful, out of all the types which had been developed by the inventors thus far. This type was brought out in July, 1915.

Immediately the resistance of the movable coil was reduced, it was found that the receiver had loud-speaking characteristics, and still retained its perfection of reproduction of speech. It was then realized that no loud-speaker could be expected to give forth loud speech unless sufficient modulated current was supplied to it, so it became necessary for the inventors to turn their attention for a time to the development of a transmitter for use in conjunction with the electrodynamic receiver. A transmitter was accordingly built that would pass a little over one ampere of modulated voice current and deliver that amount to the induction coil supplying the movable coil, attached to the diaphragm. It was found that this transmitter in conjunction with the electrodynamic receiver would give a volume of sound that was enormous and which would carry for blocks even though the original speech was no louder than a person would ordinarily talk. This, then, was the final stage in the electrical design of the elec-

(*Continued on page 215*)



Loud-speaking outfit for the public speaker. The voice is directed into the sound reflector which reflects the sound waves into the microphone transmitter

Highway Traffic Despatching

How the Functions of the Train Despatcher May Be Applied to the Motor Truck

By John Lathrop

A YEAR ago, the SCIENTIFIC AMERICAN printed an article in which I was permitted to set forth that the low per-car-per-day average movement was a, if not the, factor chiefly causing transport shortage, and venturing the prediction that, so soon as business revived, previous experiences of transport shortage would be repeated with the same harmful results.

The expected happened. Before the end of 1922, so-called car shortage was damming the normal flow of freight, seriously and to the detriment of the nation. For October the Federal Reserve Bank of New York, in its *Monthly Review*, had reported a daily shortage of 143,000 cars.

However, a most promising plan had by that time been evolved by Major Elihu C. Church, transportation engineer of the Port of New York Authority, and who as a member of the General Staff, American Expeditionary Force in France, was on duty in planning and operating the rail and motor truck service for the army overseas.

Motor truck trunk line highways, built wide enough to accommodate several lines of automotive vehicles, lighted for day and night service, equipped with telephone service for emergency calls from drivers in trouble; belt lines around heavy traffic centers coordinated with the trunk lines, and the trunk lines controlled in principle precisely as a railway is controlled by the train dispatcher method, are the elements of Major Church's proposal.

Major Church first analyzes a railway thus: (a) Right of way and bridges and other fixated properties; (b) equipment—rolling stock and motive power; (c) operation, service and train control; and (d) traffic solicitation.

Element (d) he eliminates for obvious reasons: the multiplicity of ownership and operative units in motor truck haulage, as compared with the relative unity of ownership and operation of railways.

Element (b), equipment, is, he contends, abundantly cared for by motor truck manufacturers, who have developed types suited to transportation needs.

Elements (a) and (c) are, therefore, left as the legitimate subject matter for his thesis.

First, Major Church establishes the necessity of the motor truck taking over the short freight haul, on the ground that terminal handling costs are so high that the short haul is non-profitable to the railways. This contention is now conceded by such railway authorities as Elisha Lee of the Pennsylvania, Gerritt Fort of the Boston & Maine, Vice President Powell of the Erie and others. These concede the basic statement of A. J. Brosseau, president of the International Motor Company, that the motor truck, taking over the short freight haul, "becomes the ally, rather than the competitor, of the railway, which finds its legitimate field in the long haul."

A representative case, technically analyzed by Major Church, was the motor truck haulage of less than carload lots from a western Massachusetts factory to New York City, at six dollars a ton, plus negligible packing costs; whereas, the same product, sent by rail, bore packing costs of four dollars and eighty cents a ton, costs of three dollars a ton for moving from the factory door to the door of the car, and at least three dollars a ton for getting the product from the car door in the New York terminal to the city destination. The total was ten dollars and eighty cents a ton, regardless of the railway freight rate.

Varied in detail as to place and character of freight shipped, Major Church shows that the essential principles involved are countrywide in application; that this is truly a representative case in its essence.

He next calls attention to the one million motor trucks now in commission in the United States. He points out that, in five years, at present rate of output, the one million motor trucks and ten million passenger cars in the United States—about 80 per cent of all in the world—will have grown to about eighteen million. This makes the liberal allowance of one in three discarded and written off.

"We have about reached the point of saturation in many places. Elsewhere, under existing conditions of operation and use in city and country truck traffic we have passed beyond it into uneconomic congestion. The added complement, therefore, will seriously intensify the congestion—will, in fact, cause an increase of congestion as the square of the increase of the number of additional automotive vehicles placed in commission."

As matters now proceed, no solution is in sight, and the process will be to pile a Pelion of additional automotive vehicles on an Ossa of already congested city street traffic. In the country around about the cities, there is found inefficient use of the highways—fast cars mixed indiscriminately with slower trucks, confusion general, and accidents numerous. If that be true now, Major Church asks, what will five years bring?

To forefend against such inefficiencies, he devises the co-ordinated system of motor truck trunk line highways, belt lines around traffic centers, and, most vital of all, control of traffic on the trunk lines fashioned on train control by standard railways.

Excepting for the loss of authority and unity made possible by military direction, Major Church points out that such a system, in part achieved by the American Expeditionary Force in France, is available and practical in the United States. He thus sketches the method employed in France:

The capacity of a given highway was determined; movement of motor trucks was controlled; traffic was distributed through the day and night; official passes were issued which were necessary for a truck chauffeur to obtain access to the highway; on every twentieth telegraph pole was an emergency telephone, a number on the pole, and emergency fleets of repair trucks manned by experts were maintained. Order, he cites, was evolved out of that which, before the control system had been perfected and applied, had become utter chaos.

Suited to civilian status, adjusted to State or Federal authority, intrastate or interstate traffic as it may be determined (and that not yet available), the essence of the army method in France must be had here in motor truck haulage direction.

Major Church constructs a hypothetical case to illustrate: Assume a motor truck trunk line highway between Philadelphia and New York. It is especially engineered to meet the needs. It is wide enough to permit the flow of two streams of vehicles in each direction. It has easy gradients and no sharp turns.

The principle of the "ruling grade," as on a railway, was recognized in its construction; and that and the gradual curves are necessary, because the full efficiency of the motor truck will be possible only when motor trucks may be run in trains when desirable—the traction vehicle itself bearing cargo and hauling one to four trailers. For such service, heavy grades and sharp curves would be inadmissible; for they would prevent economic speed and loading, and render impossible the operation of the truck trains. Air brakes would be necessary to yield effective control of such trains by the traction chauffeur; and for certain classes of haulage, the motor truck train would be essential to hold down ton-mile haulage costs.

A truckman desires to leave Philadelphia for New York. He telephones the highway control for a pass to start at noon. The control consults his record, and informs the truckman that the hour between noon and one o'clock is filled to the capacity of the highway. He may therefore start at one o'clock.

Inevitably, the installation of such control would at the outset enrage the hundreds of motor truck drivers and most of those who own and manage the truck lines; but the whole system or lack of system is today broken up into so many individual units, that there is no cohesion, no coordination, no order. Fleets far beyond the capacity of a highway are attempted to be run over that highway at a given time; whereas at other times there is scarcely a vehicle in sight.

It is unscientific, utterly out of tune with the proven needs and efficiencies of train control on the standard railways. Accidents are numerous. Faster cars are mixed with slower trucks. The slowest truck in the line, lumbering along with heavy load and very low speed, determines the speed of the whole line.

In the long run, probably the passenger cars and perhaps the lighter and faster trucks carrying emergency and higher class cargo, would be given passage over a line on the highway set apart to accommodate the passenger cars; or, conceivably, on some main motor truck trunk line highways there might even be six lines, three in each direction. That, however, would be determined by experience.

The method would insure evenly distributed traffic. The "peaks" would be levelled throughout the day and the night. Order would take the place of chaos, economy the place of waste of time and accident, and vastly more tonnage would move over a given highway than is possible under the existing conditions.

In brief, the order attained by train dispatching on the standard railways would be approximated. Not to attain that end, so Major Church points out, would be quite as unwise as it would be to provide sufficient standard railway rights of way so that individual conductors and engineers might say to each other some day, "Let's run over to Philadelphia with a trainload of freight this afternoon," and to attempt to handle the country's railway freight tonnage in that absurd manner.

These provisions, first, would tend to decrease street traffic congestion; second, yield greater celerity of freight delivery; third, would lower ton-mile costs; fourth, would assure greater protection from accidents, as well as quicker relief by the repair fleets; fifth, would enable the motor truck to relieve the standard railway from terminal congestion; sixth, would release railway equipment for more efficient use in the long hauls; seventh, would build a lucrative motor truck industry and service; eighth, would assist the railways financially by relieving them from the non-profitable short freight hauls; and, finally, as the most important test—to which all proposals should be subjected—would give to the shipper and ultimate consumer an economy well worth attaining.

EVERY thoughtful observer is impressed with the fact that we are threatened in places with an absolute chaos in highway transportation. The rapid rate of increase in the number of motor cars and trucks on the highways of the country has brought about a congestion of traffic that calls for some form of regulation. In the present article is presented an outline of the remedies proposed by Major Elihu C. Church, who would apply the methods which were used to control the enormous motor-truck traffic on the highways of France during the World War. His proposals include motor truck trunk line highways, built wide enough to accommodate several lines of automotive vehicles, lighted for day and night service, equipped with telephone service for emergency calls from drivers in trouble; belt lines around heavy-traffic centers co-ordinated with the trunk lines, and the trunk lines controlled in principle precisely as a railway is controlled by the train dispatcher method.—THE EDITOR.

The Cause of Specking of Ground Coat Enamels

THE Bureau of Standards has conducted a preliminary study to determine the causes of specking of ground coat enamels used for enameled metal ware. This specking appears as spots of oxides and slag in the enamel coating and seems to be due to excessive local rusting of the steel previous to the firing of the enamel. The tests thus far conducted on steel cups furnished by a manufacturer of such articles and coated with regular stock enamel, indicate that the rusting and subsequent specking are due to an excess of acid or salts in the enamel. The defect has been remedied by the addition of sodium hydroxide to the enamel previous to the dipping operation. As this defect causes a serious loss in the manufacture of enameled metal ware, and since the work so far conducted is of a very limited nature, it would seem advisable to continue the investigation on a larger number of specimens.

Microbes and Weather

PHYSICIANS have long realized that one of the most important problems of modern hygiene is the securing of fresh air; *i. e.*, air neither polluted by solid particles of dust, by poisonous or by non-usable gases, and lastly—and most important of all—air as free as possible from the germs of disease. Whenever a person infected with any one of a large number of diseases, coughs or sneezes, the result is the explosive discharge into the atmosphere of a multitude of minute particles of water, each laden with the germs of the disease in question.

A French scientist, M. A. Trillat, has spent much time in studying these "microbean clouds," by means of such masses of microbe laden droplets produced by artificial means. He is especially interested in studying the effect upon these droplets of such physical or chemical factors as heat, humidity, gravity, radioactivity, the chemical composition of the air, etc., his object being to discover the laws governing the speed of fall, the manner of formation, the mode of transport, the preservation and the multiplication of the said droplets.

His most recent notes on the subject concern the influence exerted by variations in barometric pressure upon the microbean droplets suspended in the atmosphere. In this instance he produced his artificial microbean clouds by using the microbes *prodigiosu* and *proteus*. Two series of these were made use of—the test series and the control series, placed in the same conditions of illumination and temperature under bell jars of the same volume. The microbean emulsions being made under identical conditions it was known that the number of droplets in suspension under the bell jars were practically the same.

Beneath all the bell jars were placed boxes having lids capable of being opened or closed from the outside of the bell jar by means of a special device. After the cloud was formed the heaviest droplets were allowed to fall to the bottom when the air had reached a state where it was perfectly clear and transparent. On account of containing only invisible droplets there was provoked beneath the bell jars an expression or contraction, either rapid or slow as the case might be at several millimeters of mercury. The boxes are uncovered simultaneously and reclosed after a definite lapse of time, during which they remain exposed to the atmosphere, charged with microbean droplets. By thus counting the number of colonies it was possible to find readily the number of microbean droplets which had fallen to the bottom of the bell jar during the period of exposure or, according to the manipulation of the lids, the number remaining suspended beneath the jars. M. Trillat sums up the results of numerous experiments as follows, the special object of study being the influence of a slow or rapid fall of the barometer: The effect of sudden expansion is to accelerate the fall of the microbean droplets, thus purifying the atmosphere by carrying down the suspended germs. When a slow depression takes place the precipitation is less in amount and approximates the velocity of the fall of the droplets under the control jars.

The rate at which the phenomenon manifests itself may be modified by various factors. For example, the degree of purity of the air may either accelerate or retard the fall of the droplets. Furthermore, an increase of velocity in the fall of the droplets is facilitated whenever the tension of the water vapor is at a maximum, or when there is supersaturation, a condition which is favorable to condensation.

These results may be explained as follows: the precipitation of the droplets is probably due to the increase of their weight resulting from the instantaneous condensation of the humidity upon their periphery, as a result of the cooling which they undergo under the influence of the sudden expansion. It is noteworthy that this cooling of the droplets entirely escapes observation because of its rapidity, which in turn is due to the nonconductibility of the air and to the inertia of the thermometer—the latter being doubtless the controlling factor.

If we may translate these results of the laboratory into the terms of nature, it is allowable to suppose that the fine microbean droplets present in the air are precipitated in the same manner when there is a rapid fall of the barometer, whereas a slow fall would exert only a limited effect. Assuming that the microbes may play the part of nuclei of condensation as proved experimentally, we are authorized in believing that the precipitation of the microbean particles occurs with most facility in those which are smallest, and which thus approximate, even though remotely, the dimensions of the ionized particles of air which are believed to possess great condensation power. In earlier experiments conducted some years ago, and published in the *Comptes Rendus* of the French Academy (1912, page 613), M. Trillat demonstrated the fact by experiment that barometric depression creates an atmospheric environment favorable to the life of microbes suspended in the air by reason of the fact that such a depression tends to extract from the ground infinitesimal traces of "alimentary gases." This barometric depression would exercise a double influence upon the microbes in the air, effecting both their vitality and their state of suspension.

Our final conclusion, therefore, may be thus stated: barometric depression is an important factor with respect to changes in the bacteriological contents of the air, by reason of the fact that it effects not only the vitality of the suspended germs but their concentration in the lower strata of the air and their precipitation to the ground.

The Ostwald Color Atlas

GERMANY is making desperate efforts to regain her former predominance in the dye industry by scientific improvements as well as by commercial and industrial methods. The most promising of all these is the extensive study now being given to the remarkable and highly ingenious system of color notation, comparable to that of musical notation, devised by Dr. Wilhelm Ostwald. The latter states in a recent publication that between fifteen and twenty thousand school children are already studying this system in Saxony alone, and he declares frankly that along these lines lies Germany's best chance to recover her lost supremacy with regard to pigments and dyes.

This system is undoubtedly of great industrial value, as well as of much scientific interest, since the use of color plays an important part in dozens of industries, including those of textiles, pottery, glassware, paper, paints, dyes, etc. Dr. Ostwald's object in devising his color chart and color atlas was to make color subject to numerical valuation and definition, exactly as musical sounds are by means of the art of musical notation.

For this purpose he divides the circle of pure colors, *i. e.*, the colors shown in the spectrum and their intermediate shades into 100 degrees. Instead of beginning with either violet or red, as is usual, he makes the starting point of his range sulfur yellow, which he designates as 00. This gives cinnabar red the notation of 25, ultramarine blue that of 50, and sea green that of 75. Twenty-four of these pure colors are sufficient for all practical purposes, and these may be divided into groups of three as follows: Yellow, 00-08; orange, 15-21; red, 25-33; violet, 38-46; ultramarine blue, 50-58; ice blue, 63-71; sea green, 75-83; grass green, 88-96.

But it is obvious that each of these pure colors can be modified by the admixture of white and black in various proportions; hence we may say that the pure color, plus white plus black, equals one unit. This may be expressed in an equation by saying that *p* plus *w* plus *b* equals 1. By making combinations of the various pure colors with varying proportions of black and white, Dr. Ostwald has built up what he calls a "color atlas" which contains no less than 2500 different shades. Any given shade is designated by a number and two letters of the alphabet. For instance, in the notation 29*gc* the number 29 equals the pure color (medium red), while *g* equals the percentage of white and *c* the percentage of black.

The advantages of this definite scheme of designating diverse shades by fixed symbols are obvious. Instead of matching colors by sending samples and trusting to the accuracy of the correspondent's color sense, one need only write or wire the proper notation. No longer will a textile factory be subject to the risk of having an order cancelled because the goods are off color. Rich harmonies of colors, like complex harmonies in music can be set down in precise symbols and transmitted to posterity.

There must, of course, be a special training in the use of the system and this has already been begun in Germany upon a very large scale. In Dresden a foundation for the study of the science of color (Deutsche Werkstelle für Farbkunde), was formally opened in November, 1920. In this establishment special courses adapted to various industries are given. The great textile industry located in Chemnitz has successfully applied the system since the summer of 1920. It is also planned to extend the work to Munich, Berlin, Frankfort and Nuremberg. Dr. Ostwald confidently believes that the study of his system will also develop the artistic color sense until Germany may lead the world in the art of producing harmonies in color, "as she has done for two hundred years in producing harmonies of musical tone." And in each case, he winds up triumphantly, the preeminence will be due to the application of scientific principles, to form a basis for the exercise of the art.

Electric Telemeter

DURING the past two years or more the Bureau of Standards has been engaged in developing electric telemetric devices based upon the fact that carbon contact resistances vary with pressures or displacements applied to their terminals. Many attempts have been made in the past to utilize this principle for various engineering and scientific measurements, particularly in those cases in which it was desirable to place the indicating or recording instrument at a considerable distance from the actual member or element under test, but until recently no success has been met with. The trouble in the past has been due to several inherent difficulties with apparatus of this kind. In the first place, as heretofore used, these carbon contact resistances have been very erratic in their performance and the constancy of their calibration could not be depended upon sufficiently to warrant their application to ordinary engineering uses. A second difficulty has been due to the fact that, as heretofore used, such apparatus has shown large hysteresis effects, that is, the indications of the apparatus have been very different on rising pressures or displacements than for the same values approached from a higher limit. Errors due to this cause usually reached from 20 to 50 per cent or even more.

A third difficulty grows out of the fact that these devices are inherently non-linear in their characteristics, that is, the readings of the indicating instruments are not proportional to the pressures or displacements that are being measured—a characteristic which is very objectionable in most engineering work. The Bureau has investigated all of these sources of trouble and has found means of eliminating all of them to a degree which makes the apparatus well adapted to a great variety of engineering measurements. These include measurements of strains in bridge members and other engineering structures, measurements of accelerations, vibrations and pressures of practically every description. The apparatus can be made either indicating or recording as desired. Up to the present time both indicating and recording instruments embodying this principle have been made for and largely used by the Bureau of Aeronautics of the Navy Department for measuring stresses both in airplane members and dirigibles where it is very important to read such stresses at a point more or less remote from the member under test. Similar apparatus has also been used extensively by the Bureau of Standards in laboratory tests on large structural members and also in connection with certain dynamometer work, and for much of this work the new instruments have been found to be substantially equal in accuracy to anything heretofore available in the line of indicating instruments, and they possess the additional advantage of permitting remote reading as well as graphic records to be made when desirable. Work is now in progress looking to the extension of the field of application of these instruments to the various lines of engineering work to which they are peculiarly adapted.

Strength of Welded Pressure Vessels

WELDING is now extensively used in the construction of vessels of all kinds designed to withstand considerable pressure. This type of construction has to a certain extent replaced the more familiar riveted joints.

In the case of steam boilers, there has been some doubt in the past as to the efficiency of welded seams. For a number of years the liners and cover plates, and certain portions of the fireboxes of locomotive boilers have been welded, though no additional strength was originally considered to result from this construction. In order to determine the exact value of welded joints for pressure vessels, the American Bureau of Welding has formed a committee of which a member of the staff of the Bureau of Standards is chairman. Tests are to be made on tanks to obtain information for the preparation of safety codes and especially for the use of the Boiler Code Committee of the American Society of Mechanical Engineers.

Our Smallest Toilers

How Modern Medicine and Modern Industry Are Putting Bacteria to Work

By Harry A. Mount

THE FIRST forms of life to appear on this earth were the single-cell plant and animal organisms. These lowly forms of life still inhabit the earth in countless numbers and they are about us constantly in the soil, water and air.

The lowest of animal forms, the amoeba, seem to have very little effect on human activities, either for good or ill. The single-cell plants, on the other hand, are of the greatest importance. It is no exaggeration to say, in the light of modern knowledge, that these lowly plants, called bacteria, are as important to human life as air and water. For it is quite certain that without them human life, and all other plant and animal life on this planet, could not survive for any period.

The popular reputation of the many thousands of species of bacteria has been damaged by a few "criminals" among them who do mischief in various departments of human activity. The most important of this group of trouble-makers are the so-called disease germs. In the popular imagination, all bacteria are "germs" that ought to be given a wide berth.

Compared to the good done by these tiny organisms, the harm they do is almost negligible. Science is beginning to discover the almost numberless ways in which bacteria are useful in Nature, and we are constantly finding new ways to put them to work in industry. Many industrial processes which once were expensive or impossible, now are performed by bacteria. So far this field of the commercial application of bacteria has scarcely been scratched, and for explorers in this new realm the future holds promise of rich reward.

It ought to be explained here, perhaps, that it is difficult to draw a line of demarcation between the bacteria and the somewhat higher forms of microorganisms, the yeasts and moulds. The bacteria are distinguished chiefly by the fact that they reproduce by division, while the yeasts grow by budding, and the moulds propagate themselves in true plant fashion. But each form shades off into the more complex form by gradual gradations of the species and it is hard to tell where one leaves off and the other begins. And so also their spheres of usefulness in Nature and in industry are more or less intertwined.

The bacteria are Nature's greatest scavengers. Their chief job is to attack the dead bodies of plants and animals, and, by the process we know as decay, reduce them to a form where they will provide food for future plant growth. The plant growth, in turn, provides food for animal life, and so it will be seen that the bacteria and allied forms are necessary links in the life cycle.

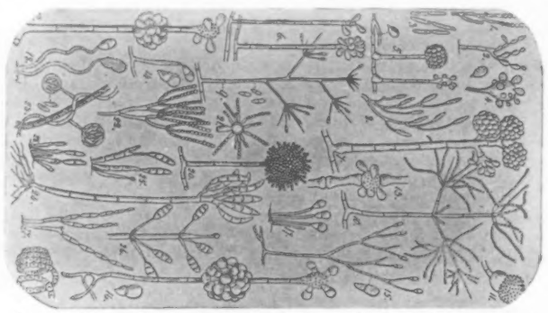
Supposing, by way of illustration, that all decay was stopped in a forest. It takes no vivid imagination to see that before very long the dead tree and plant growth would become so dense that it would crowd out the living things. Furthermore, all plant food would soon be exhausted from the soil and it would soon be impossible for either plants or animals to live there.

Thus bacteria are chiefly useful in disposing of dead things. The criminals among them are those which run amuck and attack living things. The danger from disease germs is not so much from the presence of the bacteria themselves, but from the fact that all bacteria, when active, generate complex compounds called enzymes, which have a powerful chemical effect. So powerful are these enzymes, in fact, that even a tiny quantity will cause break-down and deterioration of the tissues attacked. Animals and plants alike are troubled by these disease germs, but men have discovered through experience that certain chemicals will counteract the effect of the enzymes and around this experience is built much of the science of medicine.

It is the enzymes which make the bacteria so tremendously useful, also. The enzymes, rather than the bacteria themselves, break down the tissues of dead plants and animals, and it is the chemically powerful enzymes which may be made use of in industry.

Often it is difficult or impossible to distinguish one type of bacteria from another under the microscope; sometimes they can be told apart only by their effects under certain conditions or by observing the media in which they thrive best. The bacteria which cause typhoid fever in humans and an entirely different type which is very useful in a new scheme of city sewage disposal look very much alike under the microscope and only an expert can tell them apart. Years of research and study have been necessary to identify and isolate some of the disease bacteria and other disease germs have escaped the search of science to this very day. The difficulty is enhanced by the fact that many of the bacteria are so small that they cannot be observed, even under a powerful microscope.

In fact, although the science of bacteriology is a half century or more old, we have scarcely made more than a good beginning at identifying and studying the various kinds of bacteria. And yet men have been making good use of these tiny plants since the very dawn of history, more often than not misunderstanding the agency that was at work.



Some of the species are little more than a chain of single cells; others are more complex, resembling the familiar forms of plant life

Some characteristic bacterial forms

One of the first uses of bacteria, and one of the most extensive still, is in the manufacture of alcohol. At first bacteria were used for this purpose only in making wines and liquors. This is still an important industry, despite the activities of Mr. Volstead. Thousands of kinds of bacteria are constantly about us, but certain kinds thrive only under certain conditions, and so the conditions for growth determine the kind of bacteria that become active in making certain kinds of wines and liquors. It has often been observed that famous brands of liquors come from certain localities where they have been produced for generations, and apparently cannot be produced elsewhere. This is explained by the fact that local conditions there are propitious for the growth of certain bacteria and further that these bacteria are kept active through constant use. The vessels in which these fine liquors are made must go through a process of aging; that is, they become inoculated with the proper bacteria, and a change to new containers is nearly always fatal to the quality of the product. That is why the making of fine wines and liquors requires great skill and is nearly always carried on by families or firms of long standing.

The really important use for alcohol today, however, is not for beverage purposes. Various grades and kinds of alcohols have come into tremendous usefulness in a great variety of industries. Chiefly alcohol is used as a solvent for other substances and in making many compounds. Furnishing alcohol for industrial purposes is a great basic industry of rapidly growing importance and ought to be confused in no way with the manufacture of "drinking alcohol."

It was the troubles of brewers, whose product sometimes contracted a "disease" that spoiled the flavor, which first led the famous scientist Pasteur into the field of bacteriology. And it was Pasteur who laid the principal ground-work of the present-day knowledge of the subject. Pasteur has been called the "Father of Bacteriology" and his name has been perpetuated in the great Pasteur Institute for the study of bacteria, and in naming the process of "pasteurizing" milk.

As a result of Pasteur's studies of beer and its diseases, the modern brewer avoids this difficulty. He selects his yeast culture with the greatest care, to be sure it is a pure culture and has present no undesirable organisms. Usually the expert brewer separates under the microscope a single yeast cell which he transplants to a gelatin, and places in an incubator. A number of such cultures are started at one time. The single yeast cells bud and grow into a colony of cells, and even with the greatest of care some of them become infected with undesirable bacteria and have to be discarded. Those which remain pure and grow are transplanted to larger and larger vessels until finally a whole vat of yeast may be grown from the original single cell. The maker of "home brew" has no such facilities and often gets his yeast infected with detrimental yeasts or bacteria and records a failure which he is unable to understand.

Another wide and ancient use for bacteria is in the manufacture of dairy products. Milk is an ideal medium for the growth of nearly all kinds of bacteria. The ordinary effect is simply to sour the milk. The process of pasteurization merely retards the growth of bacteria in the milk and keeps it "sweet." Bacteria play an important part in making such other dairy products as butter and cheese. The kind and flavor of a cheese depend upon the kinds of bacteria which become active. The flavor of butter may be spoiled by the presence of one kind of bacteria or vastly improved by the introduction of another kind.

A popular health drink is made from milk by introducing a culture of the Bacillus bulgaricus. There is an interesting story in this connection. The people of Bulgaria are reputed to be the strongest and healthiest of any European nation. A Russian scientist, Elie Metchnikoff, undertook to discover the reason. He found that goat's milk is used extensively in Bulgaria and that the milk contains a high percentage of a certain type of bacteria. These he named Bacillus bulgaricus, and his final conclusion was that it was these bacteria which are responsible for the good health of the people.

He undertook to introduce cultures of the bacteria elsewhere with the result that today cultures of this particular bacillus are used in making a fermented milk drink sold widely under various trade names. The bacteria appear to have a beneficial effect in the digestive system.

The "mother" of vinegar, with which most housewives are familiar, is simply a collection of gelatinous bacteria of a type which produces the acetic acid of vinegar. And not only acetic acid, but other organic acids are commonly produced by the use of bacteria. An important new discovery in this field was made during the war when a bacterium was found which produced cheaply the acetone used in large quantities for the production of explosives.

Another use for bacteria which is of more importance than the average man suspects is in the purification of city water supplies. The city of London made the discovery some years ago that filtering water through sand beds had the effect of removing disease germs. It was hard to see how so tiny a thing as a disease germ could be stopped by filtering through sand, but an investigation disclosed that each grain of sand soon became coated with a jelly-like accumulation of bacteria to which other bacteria clung upon contact. Sand filter

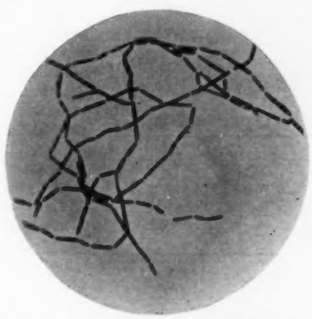
MODERN pathology has increased the population of our known world by uncounted billions. We usually get the impression that these are altogether undesirable neighbors, doing nothing but cause sickness and death. Sickness and death in plenty they cause; but, as with humans, there are good bacteria as well as bad, and the benefits which we derive from the good ones come pretty close to offsetting the woes which we suffer from the bad ones. As we come to understand the chemistry of fermentation and other processes that go on with the aid of these minute organisms, we find more and more of them that we can put to work in our laboratories and factories. It is this story of the microbe in working clothes that Mr. Mount tells us this month.—THE EDITOR.

beds are now widely used by cities which take their water supplies from rivers and lakes.

The same principle is made use of in the purification of the water from city sewage by filtering through sand beds. There are a number of other processes for the disposal of city sewage which make use of bacteria. One of the most widely used of these is the Imhoff tank method, in which the organic matter in the sewage is allowed to settle into a compartment in the bottom of a large tank, and there the ordinary bacteria of putrefaction destroy most of the sludge. Another method, which is coming rapidly to the fore, is the "activated sludge" system, which makes use of an entirely different type of bacteria that become active only in the presence of generous quantities of air and light. This method has the advantage that it is odorless and sanitary and the sludge produced has higher fertilizing qualities than from any other method.

One of the curiosities of Nature is the affinity of some plants for certain types of bacteria. Plant and bacteria are always found together and apparently depend on each other for life. Nature lovers all know the difficulty of transplanting the trailing arbutus. This is because in the soil about the roots of the arbutus is always found a peculiar type of bacterium. If the plant is taken away from this colony of bacteria it invariably dies. But the arbutus has been successfully transplanted by digging up with it a large block of the soil. The best scheme is to take up the plant in winter when the ground is frozen, so as to disturb neither plant nor bacterium.

The case of the trailing arbutus is extreme, but by no means an isolated one. A class of plants of everyday usefulness to the farmer refuses to prosper unless there is present in the soil a particular kind of bacterium, and the practical value of this fact is enormous. Plants of this kind are the pea, clover, soy bean and alfalfa. If one of these be pulled up by the roots, a number of little balls or nodules will be observed on the roots. These are filled with colonies of bacteria. The most remarkable part of this strange affinity is that the bacteria apparently have the power of drawing nitrogen, an essential plant food, from the air, part of which is fed to the plant and part stored in the soil. A favorite method of fertilizing a run-down soil is to plant such a crop and then to inoculate the soil with a culture of this nitrogen-gathering bacterium. Later, when the nodules have gathered on the roots, the crop is plowed under. When alfalfa was first introduced in this country many farmers made a failure of the crop because they failed to provide the sensitive plant with its bacterial affinity. Several concerns now make a business of supplying cultures of these nitrogen-gathering bacteria to farmers.



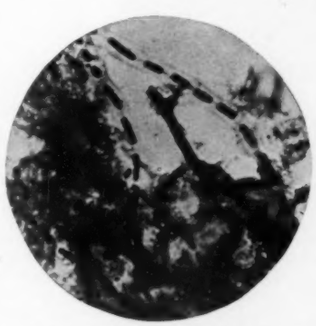
This germ is but a chain of single cells, and can be distinguished from other forms only by an expert

The bacterium responsible for anthrax

There is a growing belief among scientists that the human body has its affinity in the bacterial world, also, without which it will not thrive. Millions of bacteria are constantly growing throughout the digestive system and it is a matter of observation that when certain kinds of bacteria are present, such as the type which Metchnikoff proposed, there is a healthy condition. On the other hand a bacterial examination in a case of acute indigestion nearly always reveals a lack of these normal type of bacteria and a preponderance of other types, which apparently are harmful.

"Tests with young chicks," says Prof. D. D. Jackson of Columbia University, "tend to show that a lack of bacteria of any kind retards growth. When a chick was kept under strictly sterile conditions so that no bacteria got into its food or system, the chick failed to grow. The same chick, fed on the same food, under ordinary circumstances, grew nicely.

"Of course, tests of this kind are not conclusive, but it seems to me quite reasonable that bacteria in the intestinal tract have an important influence on digestion. Perhaps, after all, the old saying that a man must eat a peck of dirt before he dies is not without scientific foundation; but, of course, we will have to qualify it to specify what kind of dirt."



Aerobic bacteria that are used in sewage disposal. Note the individual cells, linked like a sausage chain, and covered with the almost transparent sheath that distinguishes the plant from the animal forms

One species of germ that is well worth while

We have, because of limitations of space, here given but the barest outline of the present knowledge of the usefulness of bacteria. A whole library of volumes has already been written on the subject and constant additions are being made to the literature on bacteriology.

Thousands of technical experts are employed now in industry to regulate the activities of these little plant organisms. The manufacture of yeast, alcohol and milk products alone requires the services of hundreds of experts. The canning industry, sanitary engineering, and biological medicine take hundreds more.

These experts come mainly from our large universities and in these the subject is receiving more and more attention. At Columbia, the largest of our universities, three large departments are concerned with the activities of these tiny plants. The department of biology is studying bacteria from the viewpoint of pure science, the department of medicine is concerned with the criminals of the species, and the department of chemical engineering devotes a great deal of study to the industrial uses of bacteria. In the industrial field especially we may expect to hear of important new applications.

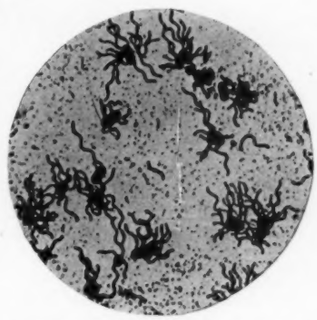
This weird design, reproduced with slight magnification, was produced by depositing a number of species on a gelatinized plate and allowing them to propagate there

A huge colony of bacteria

Mind As the Coping-Stone

A VERY interesting admission for a physiologist to make was made recently by Sir C. S. Sherrington in his presidential address before the British Association on the subject of "Some Aspects of Animal Mechanism." Professor Sherrington said: "It is to the psychologist that we must turn to learn in full the contribution made to the integration of the animal individual by mind. But each of us can recognize, without being a professed psychologist, one achievement in that direction which mental endowment has produced. Made up of myriads of microscopic cell-lives, individually born, feeding and breathing individually within the body, each one of us nevertheless appears to himself a single entity, a unity experiencing and acting as one individual. In a way the more far-reaching and many-sided the reactions of which a mind is capable the more need, as well as the more scope, for their consolidation to one. True, each one of us is in some sense not one self, but a multiple system of selves. Yet how closely those selves are united and integrated to one personality! Even in those extremes of so-called double personality one of their mystifying features is that the individual seems to himself at any one time wholly either this personality or that, never the two commingled. The view that regards hysteria as a mental dissociation illustrates the integrative trend of the total healthy mind. Circumstances can stress in the individual some, perhaps lower, instinctive tendency that conflicts with what may be termed his normal personality. This latter, to master the conflicting trend, can judge it in relation to his main self's general ethical ideels and duties to self and to the community. Thus intellectualizing it, he can destroy it or consciously subordinate it to some aim in harmony with the rest of his personality. By so doing there is gain in power of will and in personal coherence of the individual. But if the morbid situation be too strong or the mental self too weak, instead of thus assimilating the contentious element the mind may shun and, so to say, endeavor to ignore it. That way lies danger. The discordant factor escaped from the sway of the conscious mind produces stress and strain of the conscious self; hence, to use customary terminology, dissociation of the self sets in, bringing in its train those disabilities, mental or nervous or both, which characterize the sufferer from hysteria. The normal action of the mind is to make up from its components one unified personality. When we remember the manifold complexity of composition of the human individual, can we observe a greater example of solidarity of working of an organism than that presented by the human individual, intent and concentrated, as the phrase goes, upon some higher act of strenuous will? Physiologically the supreme development of the brain, psychologically the mental powers attaching thereto, seem to represent from the biological standpoint the very culmination of the integration of the animal organism.

"The mental attributes of the nervous system would be, then, the coping-stone of the construction of the individual."



Resembling as it does the octopus, this is one of the most distinctive of all microbial forms and can be mistaken for no other organism

The bacteria that cause typhoid

Architectural Acoustics

THE problem as to what constitutes good or poor acoustics, what effects are desirable in an auditorium designed for speaking, and even more in one designed for music is a question of the utmost importance, for it is of little value to be able to calculate in advance of construction and express numerically the acoustical quality which any planned auditorium will have unless the quality which is desired is also similarly capable of numerical expression. On the other hand, if the owner and the architect can agree as to the desired result, and if this is within the limits of possibility considering all the demands on the auditorium of utility, architecture, and engineering, this result can be secured with certainty—or at least there need be no uncertainty as to whether it will or will not be attained in the completed building.

When a speaker delivers an address the sound proceeds from him in spherical waves to the boundaries of the room, unless it is absorbed on the way. At the walls it may be reflected or transmitted or absorbed. In general it will suffer all three kinds of treatment in relative proportions which depend on the character of the walls. Hard and smooth walls reflect the major part of the sound, while porous and yielding walls will reflect very little. Eventually, after successive impact on different surfaces, all the sound is absorbed.

The effect of reflection is twofold. If the room is not too large the first effect will be to produce the same average loudness at different points of the room. In the case of a room 40 feet square reflections will occur at least 27 times a second. On the other hand, if the walls are hard, little energy is absorbed at each impact and very many reflections will occur before the sound dies out. This produces slow decay or reverberation, the most common defect in audience halls.

The effect of reverberation on speech is readily understood. If the sound of one word is prolonged so as to blend with that of a subsequent one no word will be heard distinctly. In music reverberation produces an effect similar to that of the loud pedal in a piano. Some prolongation and blending of notes in music is desirable; but the mixing of words in speech is never an advantage. If a hall is to be used for both a middle course must be steered. The reverberation must be made somewhat too long for speech, somewhat too short for music, yet fairly satisfactory for both.—Abstract from article by G. A. Sutherland in *Science Progress* for July, 1922.

Water to Drink

Making the Mississippi River's Fluid Fit for Human Consumption

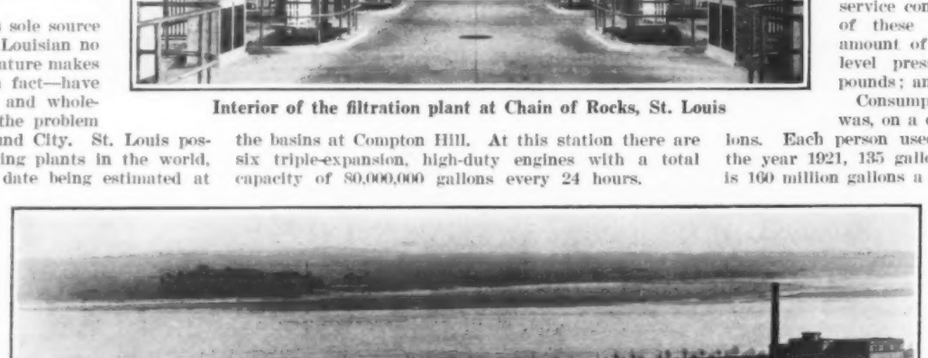
By Oliver S. Arata

AMERICA'S foremost humorist was born and brought up near St. Louis, and was familiar with the characteristics of the river water which, untreated in any way, formed in those days the sole source of supply for the cities along its banks. He tells a precious tale of residents of the river towns who were so accustomed to the brown gravy effect that if by chance a glass of water had stood long enough for the sediment to settle, they stirred it up before swallowing it. From the same source we have the story of the plaintive Easterner who demanded some other water with which to wash than that which had been given him to drink.

The river is still St. Louis's sole source of water supply; but the St. Louisian no longer takes the mixture as Nature makes it. Other cities—all cities, in fact—have the problem of getting clean and wholesome water, but nowhere is the problem more visible than in the Mound City. St. Louis possesses one of the finest filtering plants in the world, its total cost to the city to date being estimated at $33,000,000. It supplies water to something like a million people in the city and its suburbs.

Interior of the filtration plant at Chain of Rocks, St. Louis

As of old, all the water comes from the river. It enters the system through two huge intake towers, located near the Chain of Rocks. It is pumped into seven settling basins by means of four vertical compound engines, each of which has a capacity of 30,000,000 gallons per 24 hours; two twin centrifugal turbine-driven pumps of similar capacity; and one steam-driven pump that can handle 110,000,000 gallons each day. The muddy water that comes to these pumps is not fit to wash one's feet in, and something must be done to make it fit for drinking purposes. To purify the water so that the inhabitants can drink it the chemists have made a solution of milk of lime, prepared in the coagulant house. This is added before the water enters the settling basins. After the mixture of solution and water it flows through the lime-mixing conduit, and travels a distance of 9520 feet before it reaches the settling basins. It mixes as it goes through the long conduit. When it leaves the lime-mixing conduit a solution of sulfate of iron is added. The water then remains in the settling basins on an average of 34 hours. After the water is settled it is drawn into a so-called collecting conduit, and passes from this conduit through 8-foot venturi meters into two additional basins.

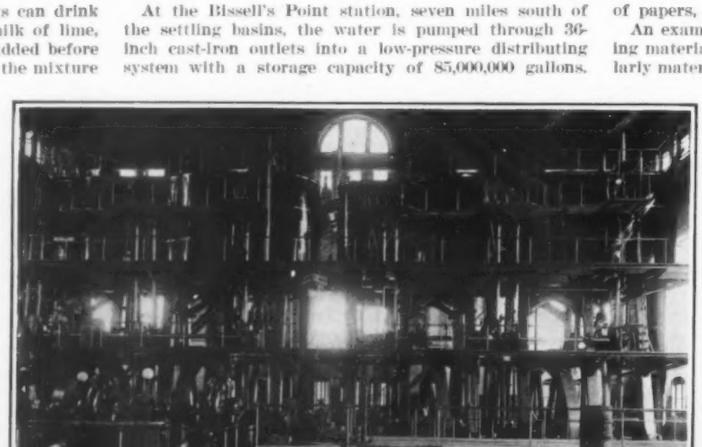


The settling basins and filter plant at Chain of Rocks

When the water passes through the meters a solution of sulfate of alumina, prepared in the head house of the filter plant, is added. After this secondary coagulation process, which is absolutely necessary, the water passes through rapid sand filters which have a capacity of 160,000,000 gallons every 24 hours. The next process sees the filtered water sterilized with liquid chlorine when it enters the conduits that lead to the high-service pumping stations, which are located at distances of 4½ miles and 7 miles from the settling basins.

The water at the Baden Station is pumped into 36-inch cast-iron outlets, thence directly into the high-pressure distributing system, which has an outlet into the basins at Compton Hill. At this station there are six triple-expansion, high-duty engines with a total capacity of 80,000,000 gallons every 24 hours.

At the Bissell's Point station, seven miles south of the settling basins, the water is pumped through 36-inch cast-iron outlets into a low-pressure distributing system with a storage capacity of 85,000,000 gallons.



Two of the triple-expansion pumps at the Bissell's Point pumping station

At this station the pumping equipment consists of three vertical triple-expansion, high-duty engines, each with a capacity of 20,000,000 gallons per 24 hours; also, three other engines of high-duty character, total capacity, 60,000,000 gallons.

The system for distribution has 1020 miles of pipes, which range in sizes from 3 inches to 48 inches. All the pipe, with the exception of five miles of it, is made of cast iron. The balance is made of lock bar steel with riveted joints. All the six service stations are centrally located in their respective districts.

Again, all services and pipes are maintained at the expense of the property owners. In St. Louis there are 120,000 service connections, and about 8 per cent of these have meters to register the amount of water used by them. Street-level pressures are, at maximum, 125 pounds; and, at minimum, 15 pounds.

Consumption of water during 1920-21 was, on a daily average, 104.6 million gallons. Each person used, on a daily average, during the year 1921, 135 gallons. The purification capacity is 160 million gallons a day, leaving an ample present margin of safety.

It cost, during 1920-21, $11.80 to purify one million gallons of water. Also, during that year, 1300 pounds of mud were taken from each million gallons purified—not to mention 48,000,000,000,000 bacteria taken from each gallon purified. There was used during the year: lime, 16,000 tons; sulfate of iron, 1923 tons; sulfate of alumina, 2264 tons; liquid chlorine, 61 tons.

Bibliography and Patents on Electrical Insulating Material

IN connection with investigation by the Bureau of Standards of the properties of certain types of electrical insulating materials, a rather comprehensive bibliography of papers, books and periodicals has been prepared.

An examination of the U. S. Patents covering insulating materials and methods of manufacture, and particularly materials of the phenolic type, has also been made, and a list of the more important U. S. patents issued prior to September, 1920, was completed. It is hoped that sometime later this list will be brought up to date because of the rapid advances in this field and the wide industrial applications.

Technologic Paper No. 216 of the Bureau of Standards deals with the properties of electrical insulating materials of the laminated phenol-methylene type, and it can now be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 30 cents per copy. Space did not permit the publication in this Technologic Paper of the complete bibliography of insulating materials or the patents list.

Since a considerable demand has arisen for copies of these, they have been issued in mimeographed form as Letter Circulars 50 and 51, "Bibliography of books and titles of periodicals on the properties and use of insulating materials" and "Lists of the more important U. S. patents covering the materials and methods of manufacture of an insulating material." Only a limited supply of these two Letter Circulars is available, but a copy will be sent on request, as long as the supply lasts, to any person who can show an actual need for them.

Shadow-Testing of Gear Teeth

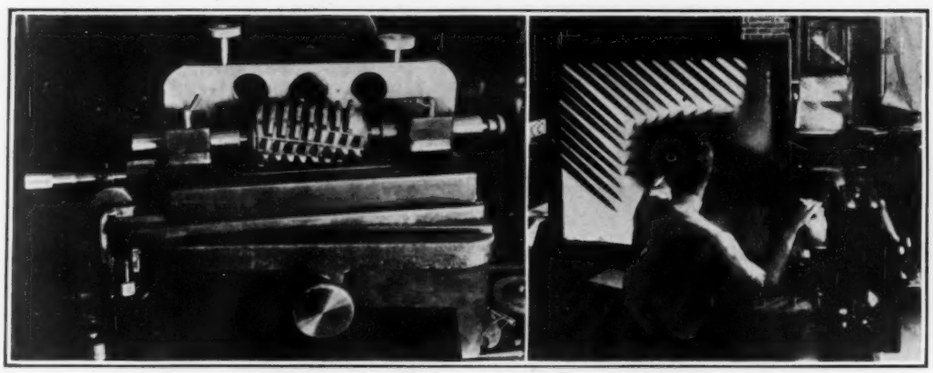
By Allen P. Child

THERE has been developed recently an interesting invention by an Eastern manufacturer which is used in connection with a comparator for testing gear teeth and gear cutter teeth. For the inspection of gear cutter outlines the comparator as used for screw thread testing must be partially rearranged. In this arrangement the cutter is mounted on a true arbor between dead centers in front of the lens. In order to take in the whole tooth the microscope has a large aperture. The image of the cutter tooth is reflected by means of an arc light against a mirror placed at a distance and this reflected image comes back to a ground glass screen near the operator. On the front of the screen the operator draws lines or erases as comparison with drawings might require and in this way many things are found out concerning a vital and difficult mechanical problem. Aside from the advantage of this system to the operator in testing there is the opportunity for a number of individuals to examine the reflected image without interference with the operation of the apparatus.

The mirror which receives the image has an actual deposit of silver on its front surface and in this way is unlike the ordinary mirror. It is claimed that such a mirror gives a more nearly total reflection of the light and avoids the double reflection from both front and back surfaces of the ordinary mirror. With a magnification of 100 diameters it is claimed that differences of .0001 inch can be detected. A valuable use of this device is found in testing the regularity of the teeth with each other. When the outline of the first tooth is drawn carefully on the screen successive teeth images may be compared with it. Differences in outline, whether due to hardening, distortion or inaccurate grinding, and also any run out of the teeth, whether sidewise or radially, are discovered by this method of comparison. The teeth of a cutter which gives satisfactory results may be compared with those of a cutter which does not give satisfactory results and reasons determined.

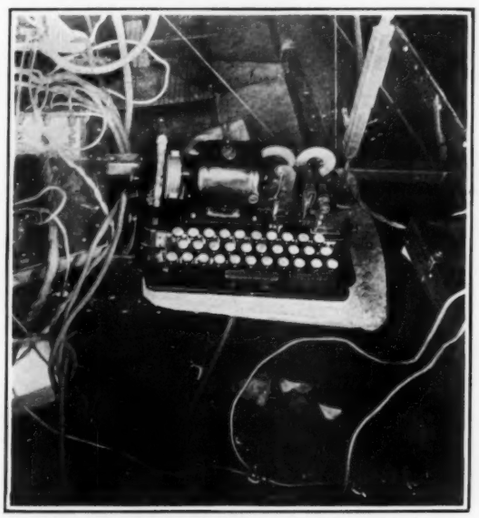
Owing to the sharp edges of the cutter teeth it is comparatively simple to compare the cutter outlines by this projection and reflection method. But in comparing gears the problem is more complicated. For here the edge is rubbed on the other side and this cannot be removed with an assurance that the true outline will be retained. Many gears, also, have chamfered teeth at one or both edges and this makes a reliable outline impossible. Until this interesting new method was devised the best method was to clamp a thin sheet of metal between two thicker blanks of the same material and cut teeth in all at the same time. A thin template was produced which had a correct outline which was suitable for projection, but such a gear could not be tested in actual running, nor could it be compared with one which had been run. This new method makes it possible to project and trace the gear tooth outlines on any section from one end to the other.

A gear is placed in a device consisting of a frame carrying a stud on which the gear or cutter is mounted, and an index pin or spring plunger carried in a holder and adjustable for diameter, and having a conical point to engage and locate the tooth space. This device is clamped on the work-table so that it makes a slight angle with the optical axis in a direction so that the tooth surfaces are displayed to the microscope. The diagram on the screen shows an outline on the focal plane whether it is located close to one end of the tooth or somewhere midway. Because of the "thinness" of the focal plane of the special microscopes used, the infinitesimal details picked out tend to give a sharp outline, but still not sharp enough for all practical purposes. In order to develop this outline a needle is mounted and focussed in the plane it is desired to explore and the point traces the tooth outline. The inventors of this method claim that the junction of the point and its reflection furnish a location for the surface measurably accurate within .0001 inch, and that it makes possible the rapid drawing of the outline with nearly this degree of accuracy. With the outline drawn, other teeth of the same gear or of other gears can be indicated with the moving needle and compared with the drawn outline. The reflected image of the needle is required for extreme accuracy, but it is claimed that roughly cut, hardened gears with the black of the furnace show some reflection under the glare of the arc light used as the illuminant.

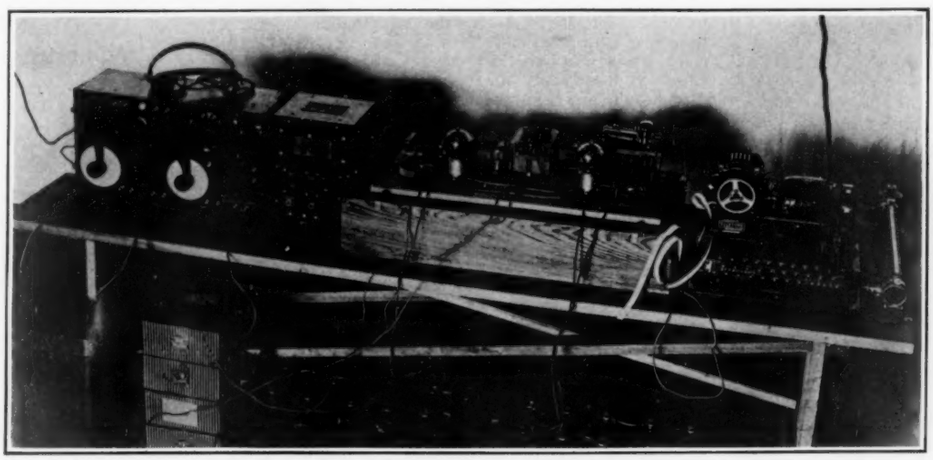


Left: A gear-cutter set up in front of the lens for testing. *Right:* The shadows that tell the story

Testing gear teeth and gear cutters by observation of the shadows which they cast



The typewriter, for airplane use, that controls another instrument on the ground through radio waves



The ground end of the apparatus—the instrument that picks up and duplicates the message typed by the aviator

The Radio Typewriter For Airplanes

By George H. Dacy

A WIRELESS typewriter called the teletype is the latest achievement of the United States Navy's aeronautical experts, the new device being improved and perfected for the transmission of messages from the ground to a plane in flight or from the airship to terra firma. The apparatus used for sending the messages looks for all the world like an ordinary typewriting machine. It is equipped with the usual alphabetical keyboard which is operated by hand in the same way as the commercial typewriter. The arrangement is such that each letter and key of the wireless typewriter is directly connected with the radio apparatus in the airplane. Immediately when a letter is struck on the keyboard of the machine, a wireless impulse is sent out from the antenna of the plane and is received at the ground station. The recording typewriter at the ground station receives messages from the air, and through the radio energization of its keyboard records the same message that is struck off on the sending machine.

For example, if the letter B, on the sending typewriter in the airplane is punched by the aviator or observer, the impulse sent out finally reaches the B key on the ground teletype. It energizes this key so that it prints its letter on the recording paper in the machine. This process is repeated until the different letters which form the words of the message are all registered. The teletype is not a new apparatus; it has been used for about eight years in connection with land radio apparatus. The naval authorities at the Anacostia Naval Air Station, in cooperation with the radio experts of the Bureau of Standards, are the first to develop and perfect the use of the teletype for the transmittal of messages to airplanes in flight.

This new wireless recorder permits of sending dispatches to aerial passenger ships. Reports on the condition of the stock market, weather reports, the receipts and prices paid at the leading markets for live stock, fruits, vegetables and grains as well as sporting and financial news may now be sent to passengers in commercial planes who are making transcontinental trips or long journeys from one city to another. Negotiations are now under way to install dependable aerial passenger service between the Pacific and Atlantic Coasts. The wireless typewriter will be a particular boon to people who avail themselves of such methods of travel.

Thus far messages have been sent by line wire teletype successfully over a distance of nine miles. The original tests have consisted in sending messages from an airplane in full flight to a ground recording station. The radio specialists are now experimenting in reversing the operations and placing the sending machine on the ground and the receiving apparatus in the airplane. These experiments promise to revolutionize the methods of sending messages from the ground to the air formerly practiced by naval experts. They will eliminate the chances for error and the need for sending the reports by code systems. Furthermore, news reports on aquatic and sporting events, the stories about fleet maneuvers and naval sham battles can now be sent directly from the scene of contest to the editorial rooms of the papers that will publish this news.

The teletype is still another effort aimed at getting along without the usual telegraph code in communicating between aircraft and the ground. While the radio telephone serves this purpose quite nicely, it is subject to serious errors in transmitting important orders. In England an automatic transmitter has been worked out whereby an airman, by plugging into any desired jack, can send a given message by the mere turning of a crank.

New Foods for Old

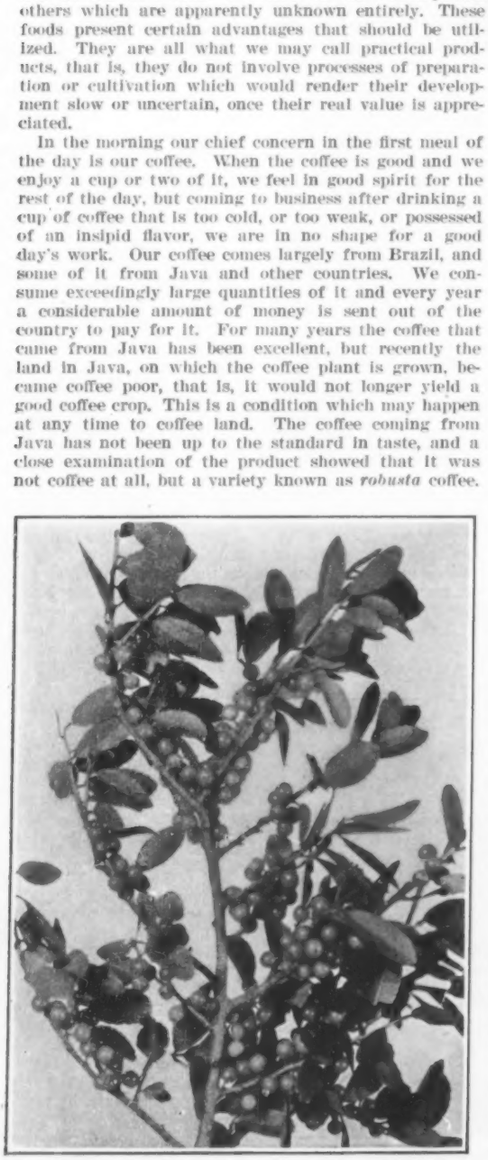
Modern Needs and Modern Enterprise vs. the Natural Inertia of Our Appetites

By George Illington

THERE is an old saying that you can lead a horse to water but you cannot make him drink. In asking human beings to try new foods, the difficulty in overcoming the inherent inertia, which prevails more or less in all of us, the tendency that we possess to go along in the same old way that we are accustomed to, the resistance to adventuring in new things, and particularly in things that concern our stomachs, is almost as great as in making an unwilling horse drink water. This is hardly a reflection on mankind, for in many ways conservatism is to be recommended, but in certain cases and this pertains to the new foods that are being developed by governmental bureaus in particular, there is a need for a little more willingness to try the new and see if it does not offer advantages which are not to be found in the old.

The story of the tuna fish is now ancient, but it took some time and considerable propaganda before its worth was recognized. Now, it is a much prized food. The same story might be told of other new foods, now, of course, old, such as the quince, the grape-fruit, etc. Today the Government is experimenting on a large scale with several important new foods, some which are known in certain localities of the country and others which are apparently unknown entirely. These foods present certain advantages that should be utilized. They are all what we may call practical products, that is, they do not involve processes of preparation or cultivation which would render their development slow or uncertain, once their real value is appreciated.

In the morning our chief concern in the first meal of the day is our coffee. When the coffee is good and we enjoy a cup or two of it, we feel in good spirit for the rest of the day, but coming to business after drinking a cup of coffee that is too cold, or too weak, or possessed of an insipid flavor, we are in no shape for a good day's work. Our coffee comes largely from Brazil, and some of it from Java and other countries. We consume exceedingly large quantities of it and every year a considerable amount of money is sent out of the country to pay for it. For many years the coffee that came from Java has been excellent, but recently the land in Java, on which the coffee plant is grown, became coffee poor, that is, it would not longer yield a good coffee crop. This is a condition which may happen at any time to coffee land. The coffee coming from Java has not been up to the standard in taste, and a close examination of the product showed that it was not coffee at all, but a variety known as *robusta* coffee.



Cassina, a perfectly good substitute for coffee if we would but bring ourselves to believe it

The familiar coffee as it looks on the tree

The robusta coffee bean looks much like the the ordinary coffee bean, but it has a distinct hook, which may be used to distinguish it therefrom.

Now in certain of the Southern States, particularly South Carolina, Georgia and Texas, there grows a bush which is known as Ilex vomitoria or cassina, which may be called the North American aboriginal tea plant. The leaves of this plant are collected and dried. From them there is brewed a drink which is very palatable and which possesses the same stimulating effect that is gained from drinking tea or coffee. The plant grows in great profusion, is easily cultivated and may be stripped continuously of its leaves during its entire active growth without injuring it. The drink that is made from this native product is recommended as a substitute for tea and coffee. It possesses the caffeine that is found in these beverages. The processes for making drinks from the cassina leaves were developed by the Bureau of Chemistry.

Our country is very large, and perhaps this fact is impressed upon our minds most emphatically when we travel through it and notice the different conditions that exist in its different parts, the different foods that are popular in the various sections. In Florida the natives have been using for a long time a starch which is obtained from the roots of the plant, known as Zamia floridana D.C., which is shown in the accompanying illustration. The Seminole Indians called this product "Coontie." It is also known by the names of "Koonti," "Compties," etc. The root of the plant is buried almost entirely in the ground and contains 30 per cent of starch. The roots are collected and the starch removed from the same by the usual methods, and from the flour are made bread, puddings, etc. The plant grows profusely and the bread made from the starch is very tasty and healthful, but outside of Florida it is practically unknown. This flour has sometimes been called arrow-root, but this is erroneous as it has no connection with the arrow-root plant. There are great possibilities for the further development and the more extensive use of this product in this country, as a substitute for the potato and other more accustomed sources of starch.

A bean of the genus Liparia has long been in use by the Indians of Arizona and Mexico, but until very recently it has been practically unknown elsewhere. It resembles the common bean, more particularly the lima bean, very closely. The important consideration about this product is that it is easily cultivated and the yield is very great. It is claimed that 4000 pounds and more can be obtained per acre of cultivated ground. The bean has been out on the market for some time, but has not gained popularity due to the fact that it has a very bitter taste, which is particularly noticeable when the water in which the beans are soaked is not removed but allowed to remain during the boiling process. The bitter taste is caused by the calcium oxalate present in the coating of the bean, and if the water in which the bean has soaked is replaced by fresh water, before the boiling is proceeded with, no trouble is encountered with bitter taste in the cooked food. In some places these beans have been used with success as substitute for the navy bean.

The plant African sorrel has been suggested as a substitute for spinach and other greens. This plant grows in almost any soil and in great profusion. The one drawback with it is that it is somewhat poisonous due to the fact that it contains appreciable quantities of oxalic acid. Just how to get around this in an efficient, easy practical manner has not yet been determined. There have been two suggestions made: one to add powdered calcium carbonate which will precipitate the oxalic acid as calcium oxalate and remove it almost entirely from solution, and the other which appears to be more practical, to soak the green in water and drain off the same with the dissolved acid, and then boil in fresh water.

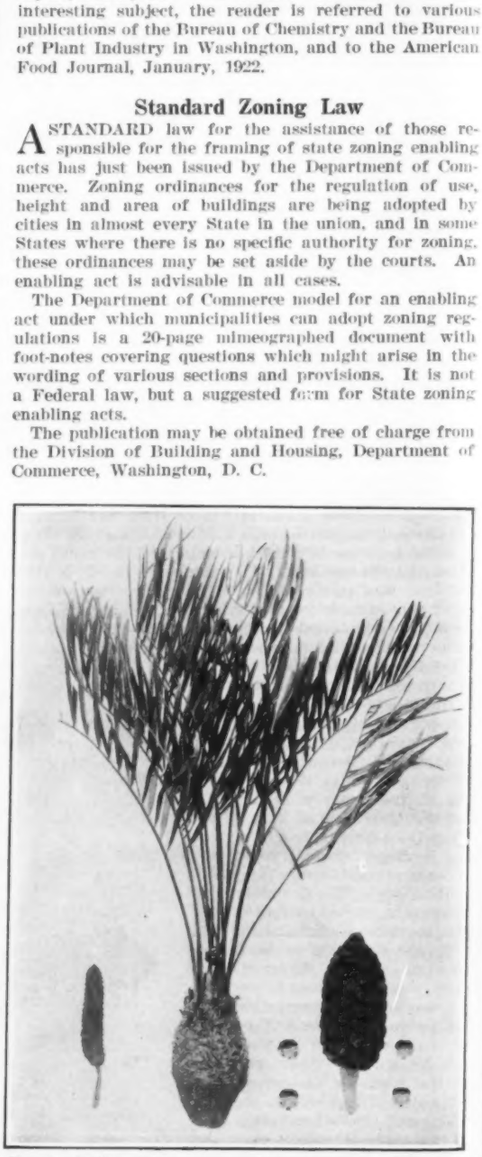
A tomato substitute, known as Solanum macrocarpum, has been imported from Madagascar and Mauritius. It looks much like the tomato but is much larger and lighter yellow in color. A substitute has been found for the expensive goldenseal, as well as for thyme, cubeb, etc. For further information on this interesting subject, the reader is referred to various publications of the Bureau of Chemistry and the Bureau of Plant Industry in Washington, and to the American Food Journal, January, 1922.

Standard Zoning Law

A STANDARD law for the assistance of those responsible for the framing of state zoning enabling acts has just been issued by the Department of Commerce. Zoning ordinances for the regulation of use, height and area of buildings are being adopted by cities in almost every State in the union, and in some States where there is no specific authority for zoning, these ordinances may be set aside by the courts. An enabling act is advisable in all cases.

The Department of Commerce model for an enabling act under which municipalities can adopt zoning regulations is a 20-page mimeographed document with foot-notes covering questions which might arise in the wording of various sections and provisions. It is not a Federal law, but a suggested form for State zoning enabling acts.

The publication may be obtained free of charge from the Division of Building and Housing, Department of Commerce, Washington, D. C.



Zamia floridana, an unaccustomed source of starch which may occupy a large place in our dietary

The huge propeller drives this boat along at a slow rate of speed

Another Air-Propeller Boat

WHILE there is nothing absolutely new in the idea of driving a boat by means of an air propeller, the craft shown in the accompanying view is distinctly novel because its builder has made use of a much larger propeller than is generally employed for this purpose. This air-driven boat has been constructed in France, where air-driven craft have always attracted considerable attention on the part of ingenious Frenchmen. It will be noted that the propeller is mounted on a tall skeleton stand, an extension of which may be used as a mast. The propeller turns at a slow rate, but owing to its large spread it moves a sufficient volume of air to propel the boat along at a leisurely speed.

A Truck That Runs on Rails and on Pavement

FROM time to time it has been suggested that greater use be made of the street railways of our great cities. During the day, passenger traffic is quite heavy and the facilities of the railways are taxed to their utmost. But at night, passenger traffic drops off to a great extent, and the railways are then working at a very low capacity. Meanwhile, the street traffic of all great cities has become more and more of a problem, and new and better ways of handling freight and express through our cities must be devised. Why not use the street railways at night? Such a suggestion has been made many times, and even now some cities are making use of street railways for the delivery of goods.

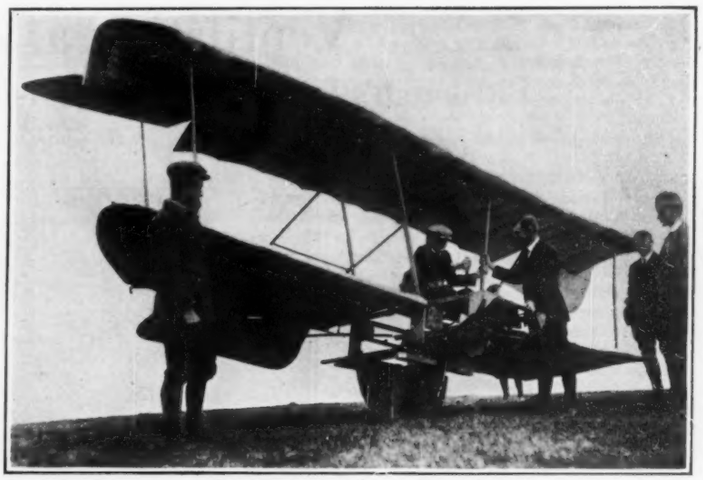
From Germany comes a suggestion which applies on this general subject. It is in the form of a truck which is provided with large wheels for usual trucking purposes, and also with smaller flanged wheels which, by means of a windlass arrangement, may be dropped down on to a track so that the truck may be hauled by a trolley car on the usual street railway system. This combination truck thus serves to transport goods from door to door, taking advantage of the street railway system for a good part of the journey.

This truck is being used in the streets of Berlin as a regular truck and as a trolley car trailer

Learning to Glide Without Leaving the Ground

CONTRARY to general belief, gliding is by no means easier than flying in the usual power-driven airplane. Of course, the layman can make a short glide in any kind of a glider, at the risk of breaking a leg or even his neck; but when it comes to undertaking real gliding and soaring flights of many minutes' duration and covering several miles' distance, it is soon learned that gliding is quite as difficult to master as power flight.

The German students who recently startled the world with their remarkable soaring flights, have, it appears, spent no little time in preparing for their record-breaking feats. First of all, they have studied the theory of flight and air currents; then they have spent considerable time studying the terrain over which the soaring flights were to be made, as well as tested the wind currents by means of thistles and feathers. Again, they have constructed their gliders only after the most exhaustive study. Finally, the pilots of these gliders have taken an extensive ground practice course in gliding, as shown in the accompanying view. By mounting a glider on a double rocker arrangement, the glider pilot student soon learns to balance his machine by means of the controls.



Learning to operate a glider on land. The double rocker arrangement enables flying conditions to be simulated

London and Its "Solid Smoke"

ONLY London can boast of "solid smoke." This is also known as soot, and some quite unpleasant statistics are made public regarding it in the annual report for 1920 of the medical officer of health in the city of London.

In order to examine the air in the city an apparatus, consisting of a large rain gage, is mounted upon the roof of one of the corporation's buildings in Goldent Lane, and the rain water from a known area of surface is collected monthly. This rain water, containing the soot, grit and dust washed from the air, is submitted for examination to the public analyst, and the results are compared with similar observations made at the Archbishop's Park, Lambeth, by the London County Council. The total solids varied from month to month, the highest in the city being 18.33 metric tons per square kilometer in September, compared with 23.11 at Lambeth, while the lowest in the city was 7.79 metric tons per square kilometer in August, as against 5.48 at Lambeth. One metric ton per square kilometer is equivalent, approximately, to nine pounds per acre, or 2.56 tons per square mile.

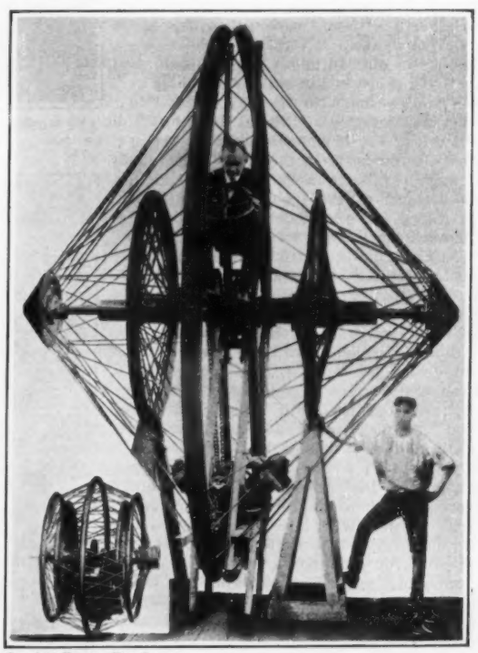
This record probably surpasses any possibilities in America, though perhaps similar incasements in Pittsburgh might nearly equal this. Nine pounds of dirt per acre, or 2½ tons per square mile, is a deposit of "solid smoke" not to be overlooked. The effect on the lungs and other parts of Londoners in general is not taken into account.

Putting the Unicycle Idea to a Real Test

OVER four years ago we described in these columns the unicycle invented by Prof. E. J. Christie of Marion, Iowa. At that time the inventor had a small working model operated by an electric motor, which is again shown in the lower left-hand corner of the accompanying photograph. Today Prof. Christie has about completed a full-sized model of his unicycle, and the idea is shortly to be put to actual test.

In brief, the unicycle is a single-wheeled vehicle capable of enormous speeds, according to the inventor's claims. It has a central axle, wire spokes, two secondary rims and a large central main rim bound solidly together to form the general wheel, as shown. The power plant is suspended below and is connected to the central axle by ball bearings, with the shaft of the motor parallel with the central axle. Two large pulleys, one at each end of the motor shaft, are belted to the inner ends of the hubs of two gyroscopes, thus transferring higher rotary speed from the motor to these two members. In the model the gyroscopes each weigh seven pounds and are 10 inches in diameter. They are mounted on ball bearings upon the central axle. The traction belt passes around a small pulley on the motor shaft and then around a large pulley fastened firmly upon the central axle. It is not operative until firmly tightened by a lever-actuated idler. The machine runs upon the outer central rim.

The full-sized model which is being completed in Philadelphia measures 14 feet high and, according to Prof. Christie, should develop a speed of 250 miles per hour. The model weighs 700 pounds, is stabilized by means of two gyroscopes, and is driven by a 250-horsepower engine. The machine runs on the outer rim and, because of the gyroscopic action of the mechanism, will not overturn. The driver sits within the wheel. Steering is accomplished by forcibly turning the gyroscopes in their paths, and the ingenious method employed for turning the gyroscope is said to enable the driver of the unicycle to turn the machine at the sharpest angles with absolute ease and certainty.



Copyright, Keystone View Co.

The unicycle in full-sized model soon ready for practical test, and, in lower left-hand corner, as a laboratory experiment

Ventilating a Vehicular Tunnel

Pittsburgh's Liberty Tube, and Its Bearing Upon the Hudson River Bore

By Charles Frederick Carter

CONGESTION of population in great industrial centers and the remarkable development of transportation by gasoline-driven vehicles together have produced a difficult problem which is now in process of solution in two notable undertakings. The engineering problem is to provide new traffic routes by means of tunnels; the difficulty is to ventilate the tunnels. The two undertakings referred to are the vehicular tunnels under the Hudson River between New York City and New Jersey and the Liberty tunnels in Pittsburgh, now well along toward completion. In both instances the problem is identical, but the solutions proposed differ widely.

Tunnels are not rare, neither is the difficulty of ventilating them new. But conditions tolerated in tunnels on busy steam railroads would be altogether unendurable in a vehicular tunnel. Smoke and steam are often so dense that nothing can be seen, while the gases are so suffocating that engine men are sometimes reduced to semi-consciousness, or more rarely, lose consciousness altogether. So long as the throttle remains open the locomotive can find its way out of a tunnel, no matter what happens to its crew.

The case of the vehicular tunnel is altogether different. Conditions which would make it possible for a wild automobile to run amuck in a crowded tube are not to be thought of. Not only must the air be clear enough to enable drivers to see where they are going, but the proportion of poisonous gases must be kept low enough to insure a steady hand at the steering wheel. The difficulty of ventilation is, of course, greater with the gasoline motor than with the locomotive.

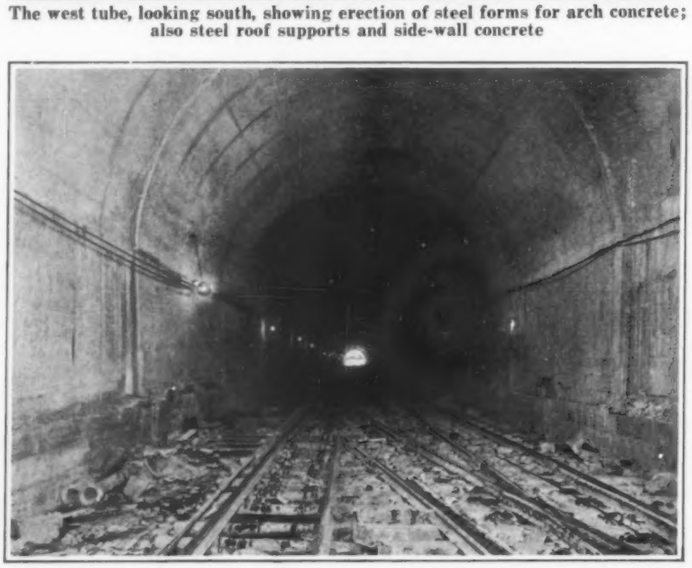
Pittsburgh was first to attack the problem. With its three thousand manufacturing plants in more than three hundred lines of industry, producing an annual tonnage of 175,000,000 tons of freight, the city, hemmed in by steep hills, long ago became intolerably cramped. The business district had taken full possession of the little tongue of land between the Allegheny and Monongahela Rivers while the factories, mills and furnaces monopolized all available space in the valleys for miles in every direction. No readily accessible room was left for additional dwellings.

South of the Monongahela River, rising abruptly almost from the water's edge, is a range of hills from 400 to 500 feet high. On account of the topography south of this range, there is no danger of industrial encroachment. This territory, known as "The South Hills District," is, in fact, the most available space on which to house Pittsburgh's growing population. A double-track street-railway tunnel built some years ago helped materially to make this region accessible, while the summit of the hills was reached by inclined planes. Even with these inadequate facilities, the population of the South Hills District exceeds 200,000, while adjacent territory south and west has 600,000 inhabitants, approximately equal to the combined populations of Indianapolis and Seattle, and more than equal to the combined populations of the two States of Arizona and Wyoming. The transportation of domestic supplies for so large a community is a formidable undertaking, while the only routes for vehicles over the hills have maximum grades of 10 per cent, upon paved streets, crooked and slippery with ice in winter.

More than a decade ago the necessity of providing better transportation routes to reach the South Hills District became so urgent that a committee of the Pittsburgh Chamber of Commerce was appointed to study the problem. As is usual in such cases there were rival routes; and as is also usual, when Allegheny County had provided funds by a bond issue of $4,600,000 to build the tunnel determined upon, the engineers ignored lay advice in selecting a location for it.

View at the south end of Pittsburgh's vehicular tunnels

The west tube, looking south, showing erection of steel forms for arch concrete; also steel roof supports and side-wall concrete



East tube, looking toward south entrance, and showing tunnel concrete complete

Approach from the north to the Liberty tunnels is to be over a monumental bridge across the Monongahela River not yet begun. Temporary access will be by existing bridges. Connecting boulevards on both sides of the river are to be linked up with good roads to the southward. The Gallatin Trail, which will give Pittsburgh an outlet to the south corresponding to the Lincoln and William Penn Highways to the east, will leave the city through the Liberty tunnels, continuing to Virginia Hot Springs via Morgantown, Fairmont and Elkins, W. Va., and ultimately on to Roanoke, Charleston, S. C., and Jacksonville, Fla. Through travel to be anticipated added to local transportation will produce a very heavy traffic through the new tunnels from the outset.

The Liberty tunnels, one for northbound the other for southbound traffic, are horseshoe-shaped bores lined throughout with concrete, 26 feet wide and 20½ feet high in the clear, 5715 feet long, or 6289 feet, including approaches, as compared with the Hudson River tubes which are to be 26 feet in internal diameter and 8500 feet long. The tunnels are 59 feet apart between center lines. In each will be a 21-foot roadway with a 4-foot sidewalk at one side and a curb on the other.

Traffic capacity of each tunnel is estimated at 1650 vehicles an hour moving in one direction in two lines with vehicles spaced 100 feet apart, traveling at the rate of 15 miles an hour. The estimated capacity of the Hudson River tunnels has been placed at 1900 vehicles an hour: but this will necessitate spacing cars less than 100 feet apart which Chief Engineer A. D. Neeld, of the Liberty tunnels, considers the limit of safety at this speed. Smoking automobiles will not be permitted to enter the Liberty tunnels, while drivers who allow their cars to smoke after entering will be liable to heavy fine.

Smoke reduces visibility and is offensive and contains other traces of poisonous gases in addition to the deadly carbon monoxide in normal exhaust. Getting rid of this carbon monoxide or rendering it harmless enough for practical purposes is the problem confronting the engineers.

Exhaustive research showed very little available information regarding the percentage of carbon monoxide in motor exhaust gas under actual road conditions, although it was known that carburetor adjustment and other operating factors varied the poisonous constituent from nothing to 12 to 13 per cent. The United States Bureau of Mines was induced to undertake an elaborate series of experiments extending over a period of ten months to provide data on which engineers of the Hudson River and the Liberty tunnels might base their calculations. A series of tests on 101 passenger cars and trucks in exactly the condition in which they were received from their owners established the fact that the percentage of carbon monoxide varied from 5 to 9 per cent of the exhaust gases. At 15 miles an hour the average car gives off 90 cubic feet of carbon monoxide an hour, or 1½ cubic feet a minute.

Prof. Yandell Henderson, of Yale Uni-

versity, who was in charge of Government investigations of the effects of poisonous gases during the war, concluded from a series of blood tests from men in air-tight cabinets into which metered quantities of carbon monoxide were admitted, that the Hudson River tunnels where the ventilating system is to be by the cross-sectional method, should limit the carbon monoxide to not more than 4 parts to 10,000 parts of air. For the longitudinal method proposed for the Liberty tunnels he thought 6 parts to 10,000 parts of air would be permissible for the maximum. Prof. Henderson found that a person at rest, as in an automobile, might endure 4 to 6 parts of carbon monoxide to 10,000 parts air for 45 minutes, not only in safety, but free from disagreeable effects.

At 15 miles an hour it would require 4½ minutes to pass through the Liberty tunnel. At maximum traffic density there would be 114 vehicles in each tunnel at one time giving off 171 cubic feet of carbon monoxide a minute. Following the recommendations of Prof. Henderson, it would be necessary to deliver 285,000 cubic feet of fresh air per minute in each tunnel.

The original plan was to blow air through each tunnel from one end in the direction of traffic. The maximum possible was calculated to be 280,000 cubic feet per minute, because to increase the quantity would require too high a velocity of blast for comfort. After experimenting with a model on a scale of one inch to the foot, using a mixture of hydrochloric acid and ammonia to produce visible smoke representing air currents, Chief Engineer Neeld discarded this in favor of a ventilating shaft in the middle of each tunnel, each shaft being divided into exhaust and supply compartments. Instead of attempting to drag air the entire length of the tunnel with a heavy expenditure of power for relatively unsatisfactory results, air will now be drawn only half way, then exhausted and replaced with a fresh current for the other half of the distance, increasing the fresh air supply from 280,000 to 500,000 cubic feet per minute. This will dilute the estimated amount of carbon monoxide from a maximum of 6 parts in 10,000 to 3 parts. Thus the air in the tunnels will probably contain less carbon monoxide gas than on Fifth Avenue in New York during the busy hours.

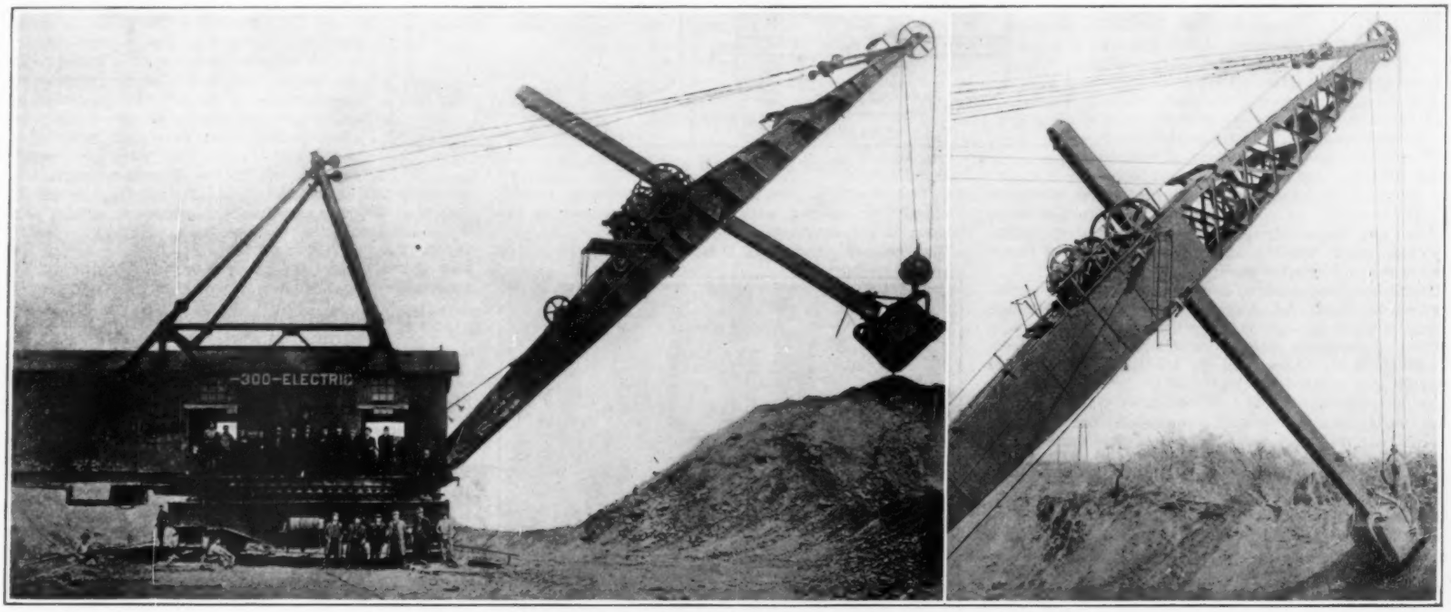
The shafts will be 12 by 36 feet, divided into three compartments. The center compartment, with a partition in the center to give structural strength, will be for the exhaust. At the tunnel roof the compartment mouth will be turned toward the current of traffic by a short curve. At the top of the shaft the exhaust compartment will lead to a plenum chamber from which two fans will draw e foul air, discharging it through a stack.

At either side of the exhaust compartment will be a supply duct down which fans will drive fresh air. Other tunnels have been provided with central ventilating exhaust shafts, but their operation has not been satisfactory. In a tunnel designed for vehicular traffic especially, it would be impracticable to control the column of air coming from each half on account of the great difference in resistance of the air moving with the traffic from one end and against the traffic from the other end. Chief Engineer Neeld's plan overcomes this difficulty.

The supply compartments discharge through a "nozzle" designed by Charles S. Churchill, formerly Chief Engineer, now Vice-President of the Norfolk & Western Railway, who has designed the ventilation for more than forty railroad tunnels. This nozzle, which is built into the walls above the spring line of the arch, consists of a semi-circular wedge-shaped chamber beginning at the spring line of the arch on either side and tapering to the end, 53 feet from the bottom of the shaft. Air is discharged through this nozzle with sufficient velocity to drive it to the portal of the tunnel.

The head house over the shafts will contain eight fans, one to each duct, with duplicate motors for each fan as a provision against accidents. While all details have not yet been determined, it is probable that 500 horsepower will be sufficient to control ventilation under any possible conditions of wind and weather as compared with estimated requirements of 10,000 horsepower for the Hudson vehicular tunnels.

Owing to the difficulty of disposing of the spoil at the north end, work was not begun there until the tunnels had been driven a distance of 2000 feet from the south end. Progress has been rapid, averaging 10 feet a day for months at a time and recently increased to 12 feet a day.



Two views of the 365-ton electric shovel, that bites off twelve tons at each mouthful.

The Biggest Shovel

GENERAL principles and due caution make us extremely wary about introducing anything to our readers as the "largest in the world" of its sort. Too often such a claim is made on insufficient facts; and again, too often it is correct at the moment when voiced, only to become out of date the next moment when some enterprising person produces another specimen of the variety under discussion, and surpassing the previous one in magnitude.

Nevertheless, it seems that for a week or two at least it ought to be safe enough to refer to the excavating giant pictured as the largest in the world. Needless to say, it is electrically controlled. When we come to quote figures on it, it loses no jot of the imposing impression that one gets on first glance. Complete as pictured, it weighs 365 tons; and every time it comes up from its stroke with a full bucket it will have moved no less than twelve tons of dirt or rock. It represents considerable economy over the process of removing material by pick and shovel.

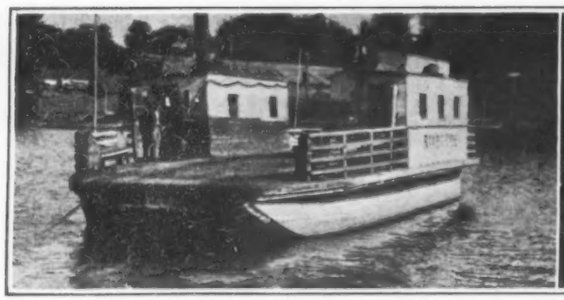
Electric Conductivity and Bio-Physical Energy

AT the Congress of Psychic Research recently held at Copenhagen, M. S. Youriévitch, of Paris, vice-president of the *Institut Général Psychologique*, gave a preliminary account of a series of startling experiments the results of which would seem to shed new and unexpected light on psychic activity as a whole. Continuing some earlier work commenced at the above institute with Eusapia Palladino (1905-1908), when the subject's hand had been found at a distance to discharge an electroscope, Youriévitch, in the course of his Petrograd experiments with the medium Ianek, noted a similar long-distance effect, viz., the discharge of insulated objects, as well as "telekinetic" effects; that is to say, the displacement of objects in the absence of any apparent material connection with the medium.

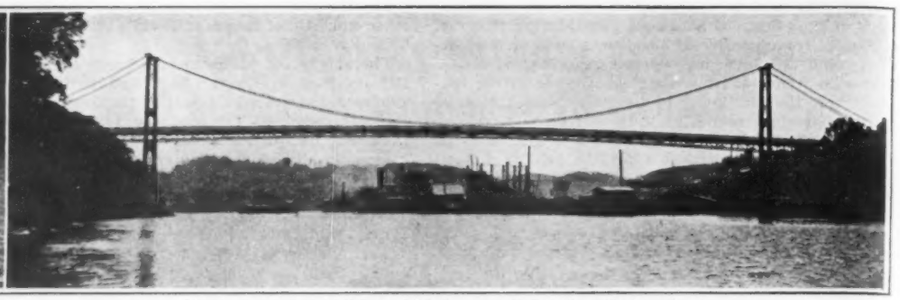
Even more interesting results were, however, obtained in the case of experiments made, in 1921, at Paris, with some members of the experimenter's own family, who, quite unexpectedly, turned out to be powerful mediums. The flow of energy issuing from the subject, which no doubt is of a biophysical or vital nature, was found to pass through any gaseous or solid dielectric substances, modifying these in such a way as to render them perfectly conductive to electrical charges or currents of any voltage and intensity. This radiation would act at a distance of up to one meter, traversing, without any apparent diminution of intensity, both non-conductors and conductors, metals, for instance, up to 1.2 inches of lead. In fact, the substance modified by the passage of the radiation becomes the exact equivalent of a thick and short metal bridge of negligible resistance. Being considerably more penetrating than the most penetrating X-rays and gamma-rays so far known, and exhibiting a striking difference of behavior from either, the rays newly discovered are provisionally called Y-rays. Not even a provisional hypothesis as to their exact nature is put forth.

In addition to their penetrating power and the conductivity produced on their way, Y-rays will through closed walls exert mechanical effects on light objects struck by them. All these phenomena have a pulsating character and sometimes take a minute or so to become apparent. Y-rays would seem to produce molecular dissociation in the metals or non-conductors traversed by them; they are confined within narrow bundles which to some extent are subject to the person's will; in fact, when several circuits are open to their action the person can at will select the one to be acted upon. Under certain conditions they will reflect light rays and, accordingly, become visible on the photographic plate. The possible connection with "psychic photography" is immediately apparent. The person emitting Y-rays, according to Youriévitch's results, expends a great amount of muscular energy, as evidenced by the remarkable exhaustion felt after the experiment. Ergograph records, for instance, are after the test a fraction of their initial figure.

It would seem to be of paramount importance for the investigation of psychic phenomena that the psychic energy operative in séances and producing physical effects, levitations, materializations, "apports," etc., has been found to possess the same properties of conduction, etc., as the Y-rays above described. Inasmuch as, for instance, all the discharging effects are incomparably more intense and more frequent in the dark than in full light, the fact that those psychic phenomena often are dependent on a more or less perfect darkness will be readily understood.



The ancient ferryboat "Skillypot"



New suspension bridge which has replaced the old ferryboat

From Horse-Driven Ferry to Steel Bridge

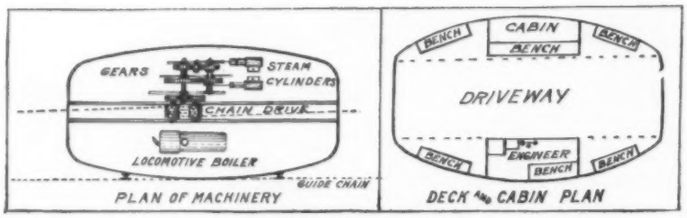
The Story of the Development of the Rondout Creek Crossing

THE OPENING to traffic in May of last year, of the new suspension bridge over Rondout Creek at Kingston on the Hudson, sealed the fate of the "Skillypot." But who or what was the "Skillypot," and what could the owner of such a name have to do with the opening by the New York State Highway Department of a bridge across one of the rivers that fall within its jurisdiction?

The "Skillypot," at the time of its retirement from service, was believed to be the ferryboat with the longest record of active operation in this country. It is only the very old people to be found living in the district served by the new bridge, who can call to mind the time when the ancient ferryboat was not in operation.

There has been a ferry of some sort or other plying between Kingston and Sleightsburg, on the opposite side of the river, ever since this section of the country was settled by the early pioneers, and long before the revolutionary war. According to tradition the original charter was granted by the Royal Governor during the reign of Queen Anne. The earliest ferry was, of course, operated by man-power and propelled by oars. Subsequently, as traffic increased and the opposite sides of the Rondout Creek became more thickly settled, the need for the transportation of wagons and other horse-drawn vehicles arose, and the first chain-operated ferry was built. The chain-ferries of early times, and in later days for that matter, consisted of a flat-bottomed scow moved by means of a chain laid across the bed of the river, which passed over the deck of the scow, where it took a few turns around a windlass, by the turning of which the craft was moved slowly from bank to bank. The first ferry of this type was operated by man-power. As traffic increased this was replaced by a team of horses on a treadwheel connected to the drum over which the chain was found.

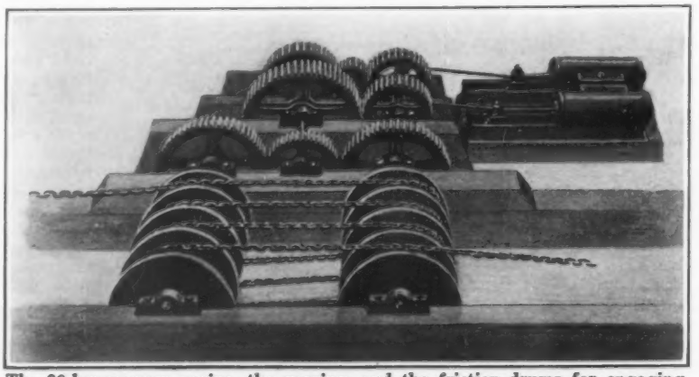
When steam power became available, the curious little craft which forms the subject of our illustrations was built; and it will be seen that in a very crude way it contained several of the elements of the large modern ferryboats which ply the Hudson at New York City. The two accompanying plans show the floor of the boat and its upper deck. The chain entered the hull below deck and passed through an enclosed wooden runway, in the center of which were a pair of cast-iron drums, each formed with a spiral groove which was engaged by the chain. To secure sufficient friction and prevent the chain from slipping it was wound three times around the two drums, as is shown in our sketch of the engines and gear. Power was supplied by a two-cylinder, high-pressure engine of 30 horsepower, which drove the two drums through the curious train of gears shown in the picture. The engine and gears were placed on the floor of the boat on one side of the center line, and steam was supplied by a locomotive boiler carried on the opposite side of the floor. On the upper floor were two deckhouses, in one of which the engineer was stationed, the other being a cabin for passengers, with a bench running down one side of it. Our view of the engineer's room shows the top of the steam drum, and the steam pipe connections running from this drum down to the engine below. Just beyond the first elbow is the throttle valve with its handle "lagged," or covered with a piece of leather for the benefit of the engineer.



Plans of the hull and deck

The clumsy crudity of these fittings carries every evidence of the antiquity of this interesting old craft. In addition to the seating capacity in the diminutive cabin, four benches were provided in the open, as shown in the deck and cabin plan. We are told that the correct name of this historical craft was the "Riverside"; but we are also told that only the painter who traced the letters on the side of the boat knew her by that name. The nickname "Skillypot" is a corruption of an old Dutch word which means tortoise, and her slow speed made the name "Skillypot" seem particularly appropriate. It appears that tourists also dubbed the old craft "The other side," because more often than not when they reached the creek the "Skillypot" would be tied up at the opposite bank. The traveling public, and the motorist in particular, will rejoice that Rondout Creek is now spanned by a handsome bridge, and only the sentimentalist will feel a pang of regret that the falling off of fares after the bridge was opened has caused the passing of one more of the old landmarks of the Hudson River Valley.

The engineer's "cab," showing steam drum, throttle valve, etc.



The 30-horsepower engine, the gearing, and the friction drums for engaging the chain

Spectrophotoelectrical Sensitivity of Bournonite and Pyrargyrite

WHEN certain substances, for example, selenium, are exposed to light, their electrical resistance is greatly decreased and they are said to be photoelectrically sensitive.

It is not known what causes this change in resistance, and the Bureau of Standards has been making a systematic study of the phenomenon, hoping to find the cause. In Scientific Paper No. 446, just issued, it was shown that crystal structure is not the underlying cause of this phenomenon, which appears to reside within the chemical molecule. If this is the case, then the photoelectrical sensitivity of a compound should be different from that of its constituents, one or all of which may be photoelectrically sensitive. Fortunately we find in nature two minerals which provide a means of testing this hypothesis. These minerals are proustite (Scientific Paper No. 412), which is a double sulfide of silver and arsenic, and pyrargyrite, which is a double sulfide of silver and of antimony, described in the present paper.

In previous papers it was shown that antimony sulfide (Scientific Paper No. 398) and silver sulfide (Scientific Papers Nos. 344 and 446) have a spectrophotoelectrical sensitivity peculiar to these two compounds, while the sulfides of copper, lead and arsenic are not at all photosensitive. The present investigation of bournonite (which is a compound of the sulfides of copper, lead and antimony) and of pyrargyrite) (which, as already stated, is a compound of the sulfides of silver and of antimony) shows that the photoelectrical sensitivity of these two compounds is entirely different from the constituents. This is in agreement with previous investigations on the absorption of light of different colors in which it was shown that the absorption bands of a compound is not the composite of the absorption bands of the constituent elements forming the compound.

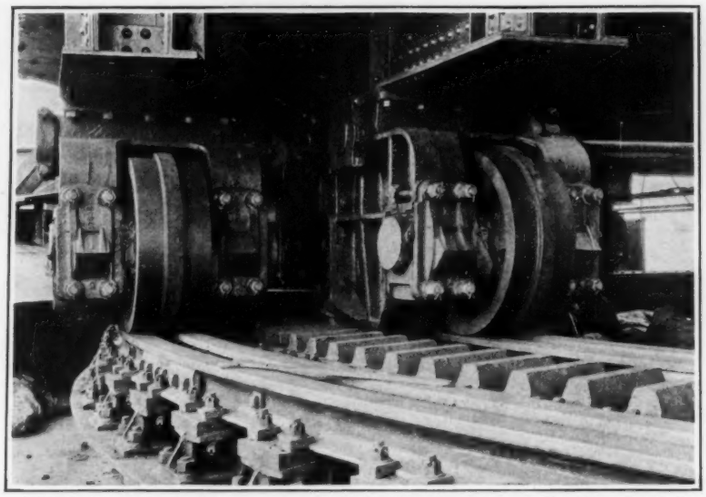
These investigations, therefore, show that the cause of photoelectrical sensitivity lies within the molecule, and is affected by the atoms or groups of atoms within the molecule.

This latest work is described in Scientific Paper No. 451, which will be ready in a short time and may be obtained from the Superintendent of Documents, Washington, D. C., at 10 cents a copy.

From Battleship to Floating Crane

UNDERGOING final acceptance tests in the Navy Yard, Philadelphia, Pa., the U. S. Navy Craneship No. 1 presents one of the most unique and interesting results of modern naval construction. This craneship, the first of its kind in the history of shipbuilding, consists of a mammoth electrically operated crane built on the hull of a dismantled battleship, the U. S. S. "Kearsarge." The "Kearsarge" was the fifth battleship built by the United States and was launched by the Newport News Shipbuilding Company at Newport News, Va., in 1899. She was in commission during the recent war, but has long been obsolete.

The crane proper consists of a steel structure resting on six sets of trucks, supported on double-flanged wheels, revolving on a circular four-rail track 60 feet in diameter. Two main hooks, each of 125 tons capacity when connected by an equalizer bar and hook, give a maximum capacity of 250 tons at a radius of 101 feet; while an auxiliary hook of 40 tons capacity operates on a track running between the main hooks and has a maximum radius of 174 feet. The radius of the main hooks can be varied only by raising and lowering the boom, or jib as it is called in this case. This is done by means of two screws, each operated by a 110-horsepower motor. The main hoists will lift the maximum load from a point 40 below the base of the crane to a point 103 feet above the base at a speed of 6 feet per minute.



The 60-foot, four-rail track, on which the 250-ton crane of the "Kearsarge" rotates. Note the massive trucks with double-flanged wheels, which carry the rotating mass of 2000 tons

Many problems have been encountered and overcome in connection with the design and construction of the craneship, the crane of which was designed and built by the Wellman-Seaver-Morgan Company, of Cleveland, Ohio; while plans for the alterations to the hull of the "Kearsarge" and the building of the cradle to support the jib when the crane is not being used, were made by the Bureau of Construction and Repair at the Navy Department in Washington and the work carried into execution by the Navy Yard, Philadelphia.

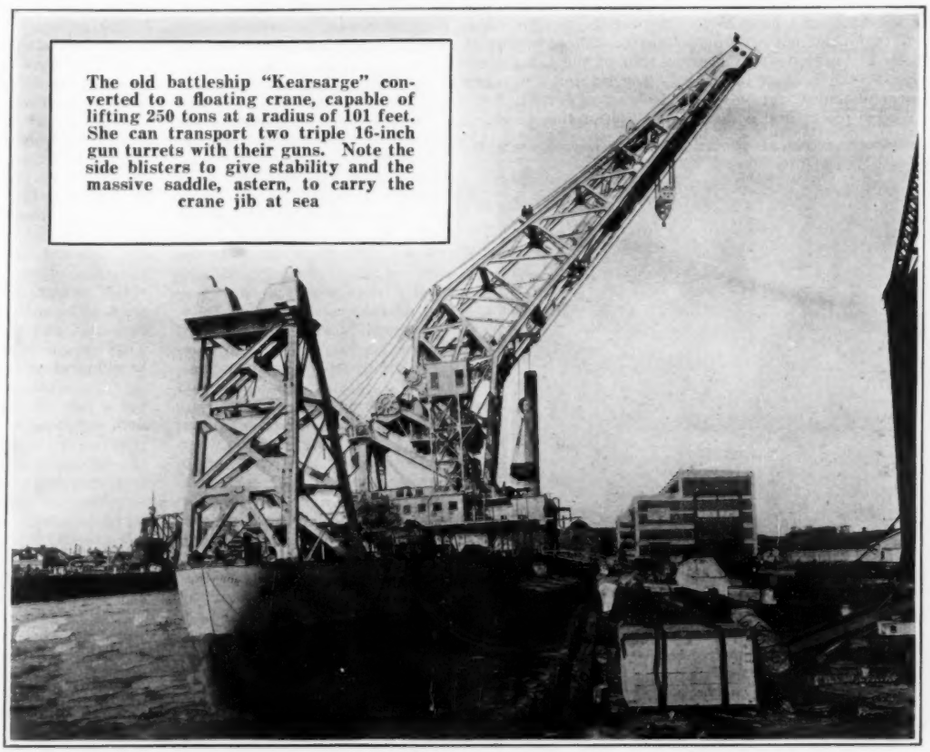
The first serious problem encountered was that of increasing the flotation and stability of the vessel. This was accomplished by removing the entire side armor (which was later used in making a counterbalance for the crane) and by putting a bulge or blister, 20 feet wide, on either side of the vessel for 75 per cent of its length. The draft was in this way reduced to 20 feet making it possible for the ship to go up the Potomac to the Navy Yard, Washington, if necessary, and the stability was increased to such an extent that, with the crane lifting maximum load directly abeam, there will be a list of but four degrees.

One of the interesting features of the craneship is that the decks have been reinforced forward and aft so as to be capable of supporting a 16-inch turret with three 16-inch guns installed, or an equivalent weight. Securings have been provided, and it is expected that the crane will be able to go to sea loaded in this manner. While it will not be able to lift submarines clear of the water, it will be able to support them while repairs are being made. Some idea of the size of the crane can be gained from the fact that the revolving mass is calculated at approximately 2000 tons. This mass can be rotated any number of times in either direction, and through a complete circle in less than 12 minutes.

The building of a cradle for the jib of the crane, so that there would be no danger of it getting adrift in a seaway, was a difficult feat; for the side thrust, at a point over 40 feet above the deck, in case the vessel were rolling 25 degrees either side of the vertical, was calculated to be 460,000 pounds. The tendency of the jib to jump out of the cradle, with the ship pitching, was taken into consideration, and provision for holding it in place was made in the hoisting gear by using solid screws instead of cables. The weight of the crane is so great that rivets could not furnish the necessary strength, and the supporting angles to the vertical plates and bulkheads beneath it were welded to them as well as being riveted.

Power is furnished for the propulsion of the vessel as well as for the operation of the crane by four Mosher water-tube boilers located in the forward boiler room. This is one-half of the original boiler installation.

Coal will be used as fuel. The "Kearsarge's" engines remain intact and are expected to give the vessel a speed of seven knots. The after boilers have been removed and turbo generators, 200 kilowatt, 230 volt, two in number, have been installed. These will furnish current to the eight operating motors.



The old battleship "Kearsarge" converted to a floating crane, capable of lifting 250 tons at a radius of 101 feet. She can transport two triple 16-inch gun turrets with their guns. Note the side blisters to give stability and the massive saddle, astern, to carry the crane jib at sea

Night Lights without Insects

EVERY locality has its insect pest, which is more or less serious, according to the character of the season and the identity of the insect. Especially towns situated along rivers and lakes suffer from vast hordes of moths, dragon flies, sand flies, "Mormon flies," and numerous other species which, usually, are grouped locally under the all-inclusive title of "bugs."

Keokuk, Iowa, has recently introduced a novel but scientific cure for this sort of thing. The pest is of course worse at night and in the neighborhood of lights. Keokuk has discovered that the attraction of the bright lights for insects is a matter of wave-length; that it is greatest for the short waves near the violet end of the spectrum, and practically zero at the red end. Keokuk's prevention method depends upon this fact.

Electric globes are colored a light red by dipping for use in lunch rooms, dancing pavilions, bathing beaches, country-club houses, and street cars—which are the places where the pest is most active and most disagreeable. Illuminated with rose lights, the street cars run through the night entirely free of bugs, though these had previously been so plentiful as to interfere with traffic receipts.

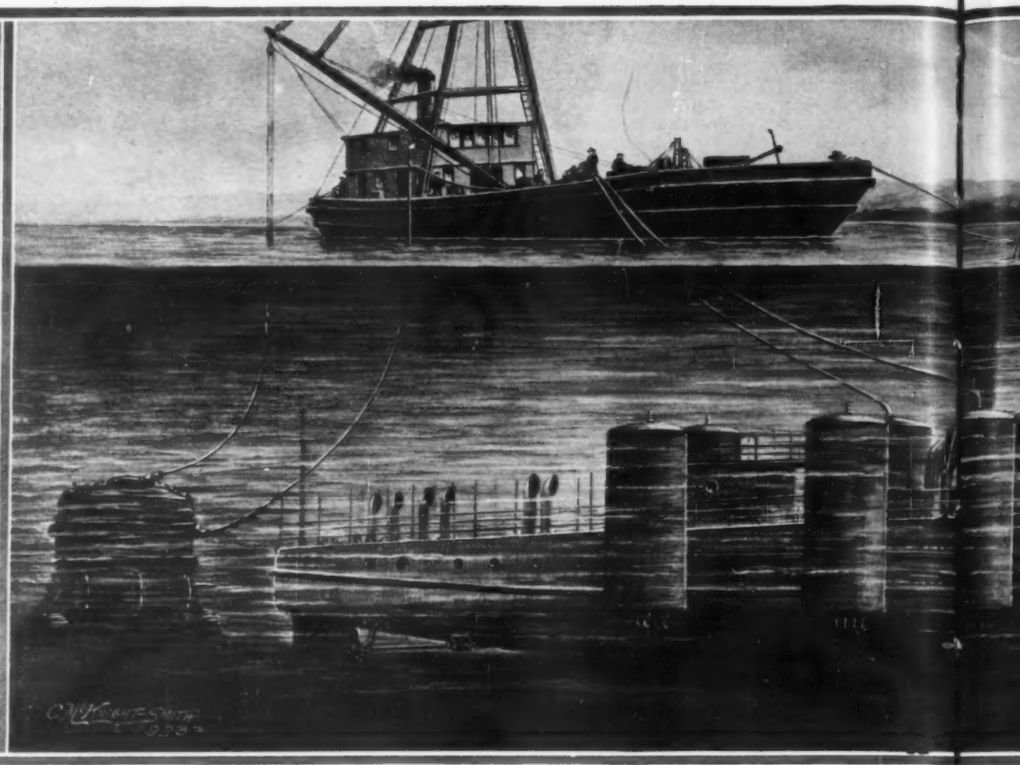
The application of this principle, if not its actual discovery, was accidental. John Brazill found that his lunch-wagon business was drifting upon the rocks because the bugs prevented anybody from patronizing him in comfort after sunset. He reasoned that if he dimmed the lights in the wagon, the brighter lights outside would attract the insects away from his counters. So he wrapped all his lights in tissue paper, using what he happened to have about the place—which chanced to be red. Later he had the globes dipped in red. The idea gradually spread, and was tried out in sufficient variations to prove that it was really the red lights, rather than anything in the way of mere relative dimness, that did the trick.

Sensitive passengers complained about the too-brilliant red color of the bug-proof lamps first installed on the street cars, and these were toned down to a delicate rose. This was found just as effective against the insects, and quite unobjectionable to the passengers. With the use of this artifice, Keokuk today finds night exactly the same as day, as regards the presence of bugs in the air.

Determination of Carbon Monoxide

CARBON monoxide may occur in many places and inhalation of that insidious gas is a frequent and widely distributed cause of poisoning, ranging in severity from headache and inefficiency to unconsciousness and death, according to the Bureau of Mines. People are continually being affected by carbon monoxide in the home, in garages, around gas and gasoline engines and blast-furnaces, in fighting fires, after blasting in mines and quarries, and after mine fires and explosions; in fact, everywhere there is the possibility of an exposure to the products of combustion of carbonaceous fuels or products. On the other hand, there are many cases reported where ill effects and accidents are wrongly attributed to carbon monoxide. Thus it is essential indeed for doctors, coroners, safety engineers, and first-aid men to be able to recognize this poisoning, not only as regards giving proper treatment, but to ensure just decisions on claims and to eliminate false illusions and complaints of workmen. A method which is believed to be particularly adapted to the determination of poisoning by carbon monoxide is outlined in Serial 2356, "The tannic acid method for the quantitative determination of carbon monoxide in the blood," which may be obtained from the Bureau of Mines, Washington, D. C., by anyone who is particularly interested in the subject.

Lowering the tractor into 60 feet of water



Salvaging an ex-Eagle gunboat from the bottom of Long Island Sound. This view shows everything set final lift. have been filled with air; and the final supply is bei two lin

New Method of Salv by

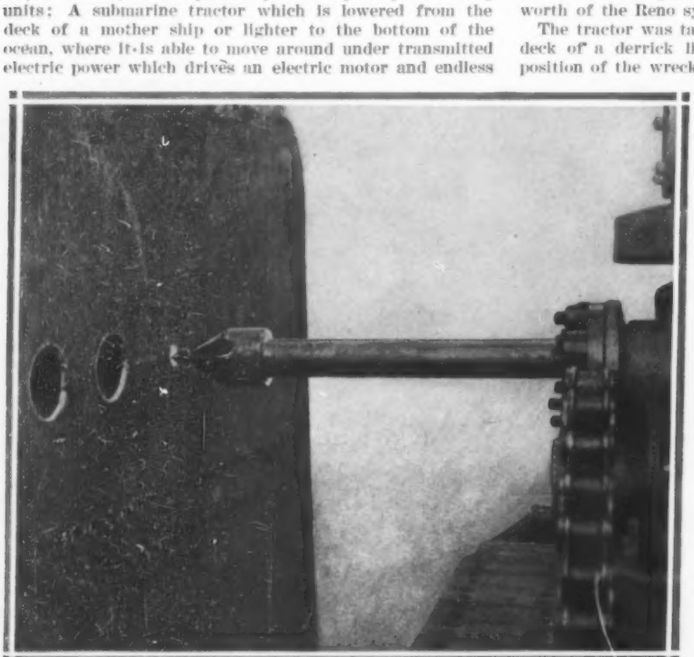
A Submarine Tractor Makes Possible Ig of S

A GREAT step forward in submarine salvage was recently taken by a salvage corporation, in their experimental work in Long Island Sound, which may lead to the recovery of a large part of the ships and cargoes which were lost through submarine attack during the late war.

Realizing that past salvage practice had been hampered by the dependence on surface devices, and because of the limit placed on the depth at which divers could work efficiently, Jesse W. Reno, of New York, developed the system described in the accompanying article, which has just been subjected to a thorough demonstration test in about 60 feet of water in Long Island Sound near New York. The system depends upon two principal working units: A submarine tractor which is lowered from the deck of a mother ship or lighter to the bottom of the ocean, where it is able to move around under transmitted electric power which drives an electric motor and endless tractor belts; and open bottom, vertical, submersible pontoons which are attached to the sides of the ship by means of hooks inserted in holes drilled in its sides by the tractor.

The work in Long Island Sound was performed on the hull of Coast Guard Cutter "Scally" (illustrated), formerly one of the Eagle boats. She is 200 feet long, 25-foot beam and 18 feet molded depth, with a displacement rating in commission of 500 tons. She was recently sold by the Coast Guard Service to be scrapped and, while in tow up the Sound, was sunk through carelessness in taking on water ballast. As the position in which she sank made her a menace to navigation it was necessary to have her removed. The corporation undertook the work to prove the worth of the Reno system.

The tractor was taken to the scene of operations on the deck of a derrick lighter which was anchored over the position of the wreck. The tractor weighs 18 tons on the surface and is lowered to the bottom by the derrick whose lowering cables are attached to a "tripod" arrangement of heavy chains secured to the top of the shell of the chamber (illustrated). Two men who form the crew of the machine are supplied with air by the same system as that used in submarines. This consists in the removal of the carbon-dioxygen gas by passing the air through soda lime, and the release of the oxygen content from an oxygen tank taken down in the machine at the time it is lowered. The working chamber is seven feet in diameter and nine feet high inside and has a contained buoyancy of about ten tons, so that the tractor on the bottom weighs about eight tons.

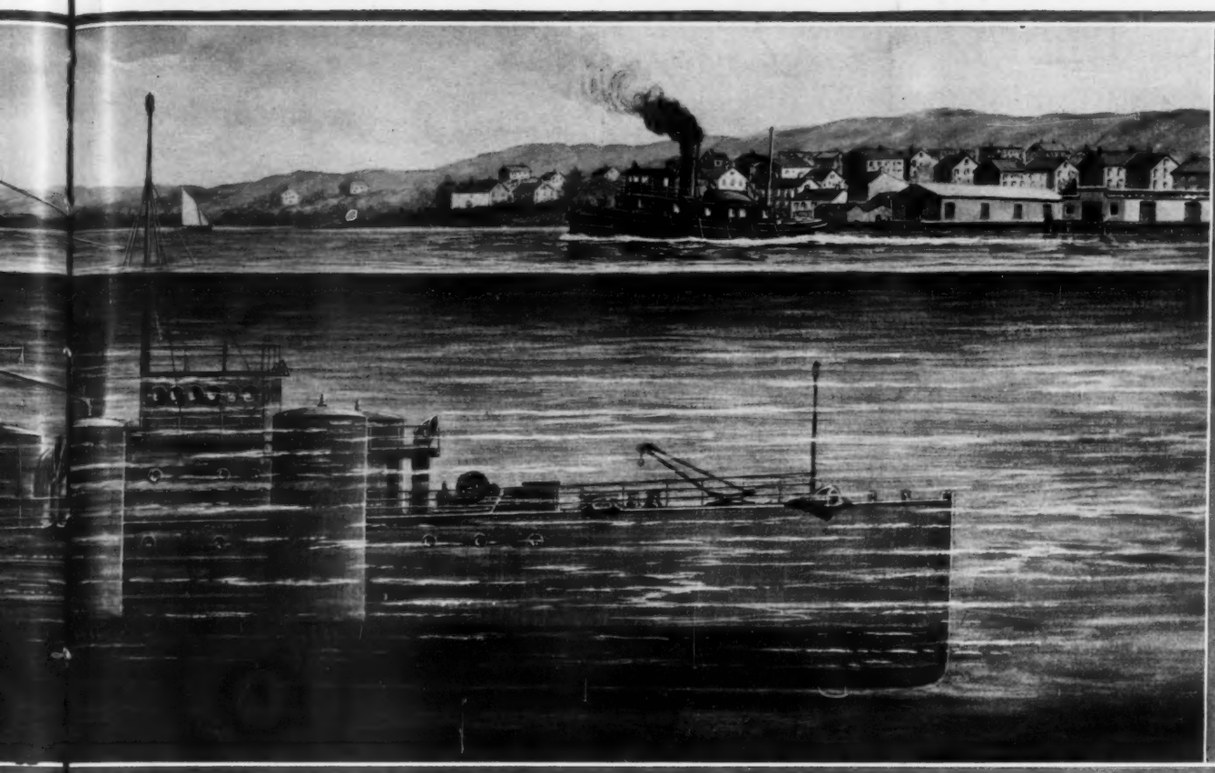


A drill and reamer, operated by electric motor within the tractor to the right, drilling holes for the lifting hooks

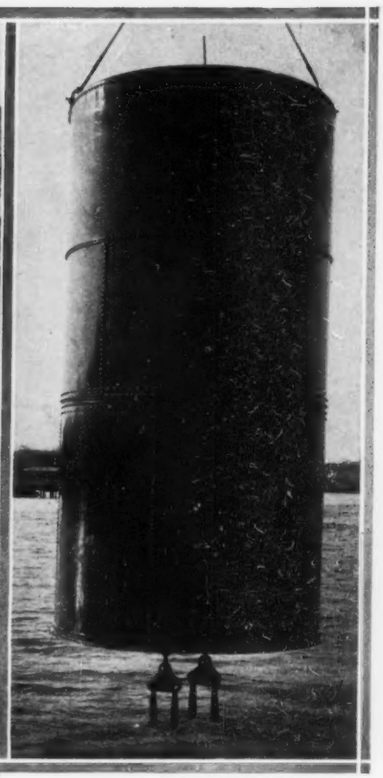
Power is supplied through an electric cable leading from the generator on the mother ship to the tractor. This cable contains four wires, two of which are telephone and two power. All the operations of the tractor are performed by one electric motor, which through gears and clutches drives the tractor belts, the drills and the lowering drum. When lowered to the bottom diamete tractor rested on a firm sand bottom which the opera tons di found to afford excellent traction. No difficulty was fety is al perienced in driving the tractor ahead or in reverse, iced. elt running one belt ahead and the other in reverse, the the ribs chine was turned with ease in little more than its The hole length. The tractor was put overboard several times lustrated allow the men to become accustomed to its operation to adjoini then they were sent down to perform the actual wor ns over

On ordinary bright days in not over 60 feet of wa toons w there is sufficient light for all operations, but on dull da were l and in deeper water light is supplied by means of fe lifted b powerful searchlights so placed on the outside of t are lo tractor that two of them may be trained on the operat er wate at one time. When lowered the men found no difficu opened in bringing the tractor alongside the ship on a co was all parallel to the side and about four feet from it. ve and v power was shifted to the drills and the drill shafts wen the w fed forward until the drill points were in contact w is trap the side plates. Stuffing boxes prevent any leakage ough buo water through the apertures through which the drill shan, but ju pass. The drilling is performed by means of a comb attached tion drill and reamer head on the end of the drill shaft driven This head consists of a drill point one and one-half inc allel cut in diameter followed up by a reamer which reams the hich is bu to a diameter of five inches. The operators were able weight put a hole through the plates in about nine minutes. buoy is drill was then removed and the tractor moved along to toons b position of the next hole. It was surprising how accurately tor is r the operators could center the drill. To assist in this directly tractor belts are geared so that the machine moves very from slowly—about 30 feet a minute—and the drills were unwound, tered to within less than an inch of the desired point toons ha

Some doubt has been expressed as to the strain to a po could be put on the ordinary side plates of the ship. by is at test this a section of a ship side was made up of ed over plates riveted together and these plates riveted to ordi ched to ship channels or ribs. The section was taken to the for the to ing laboratory of Columbia University and put on phone th hydraulic testing machine. Two holes were drilled in the b each of the upper and lower plates and a pair of hooks the placed in each pair of holes. The plates used were that tons h eighths of an inch thick and stood a pull of more by is abo 31 tons per hook. As the plates of the ordinary of the oper ship are half inch, or over, thick and the pontoons, 12 cient to



ning set final lift. The eight pontoons have been attached by hooks to holes in the ship's side, drilled by the tractor shown astern. They dy is being two lines of hose leading from the barge to the central pontoons.



Lowering a pontoon with its lifting hooks

Salv by Compressed Air

ble l of Ships from Unprecedented Depths

bottom diameter and 35 feet long, have a lifting capacity of e operat tons distributed over four hooks, an ample margin of lty was fety is allowed. In the test no starting of the rivets was everse, iced, either in the lap of the plates or where riveted se, the the ribs.

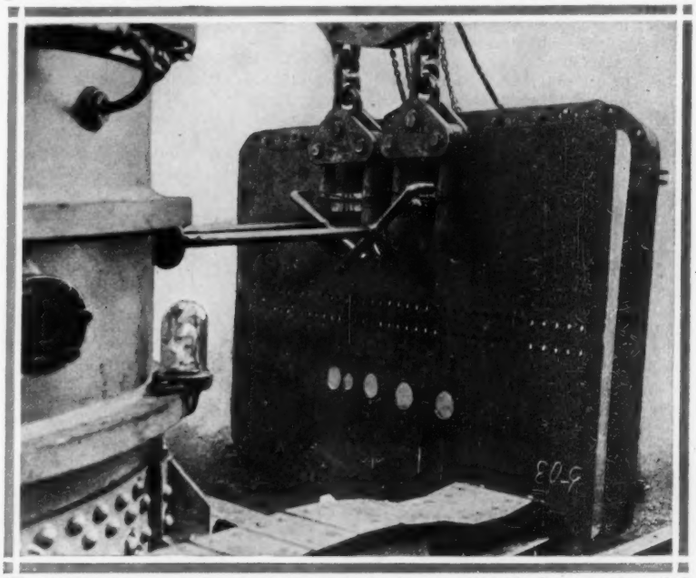
an its of the holes in the ship's sides were drilled in sets of four al times ustrated), a pair of holes being drilled on each side of eration o adjoining ribs. This distributed the pull of the pon- ual wor ns over three ribs. Eight pontoons were used. The et of wa toons were taken to the scene of operations on a barge n dull dri were launched overboard by a derrick. The pontoons ns of te lifted by a pair of bails placed at the top (illustrated) ide of th are lowered until the lower lip of the pontoon is e operat ler water. An air valve in the head of the pontoon no difficu opened, and as the pontoon was lowered the contained n a cer was allowed to escape. Leading down from the air m it. Ve and within the pontoon is a pipe long enough so that shafts wh the water rises to the bottom of this pipe sufficient ontact w is trapped in the head of the pontoon to provide leakage ough buoyancy to float the pontoon in a vertical posi- drill she, but just awash.

a comb Attached at the rear of the tractor is a winding drum rill sha driven by the motor. Round this drum are wound half inc allel cables, the ends of which are attached to a float ns the h which is buoyant enough to rise to the surface carrying ere able weight of the cables. While the tractor is drilling, nutes. buoy is not attached, but when lowered to handle the long to toons buoy and tractor are lowered together. The accura tor is manouvered into position head on to the ship in this directly in line with a set of holes. It is then backed moves way from the side of the ship about 20 feet and the drum were unwound, allowing the buoy to rise to the surface. The d point toons have welded down the side, from the line of flota- strain t to a point below the center line, a T rail. When the e ship, y is at the surface one of the floating pontoons is up of ed over to the position of the buoy and an open dog, o ordi ched to the buoy by a flexible connection, is dropped o the t the top of the rail. The operators are notified by ut on phone that they are connected and they start to haul drilled n the buoy. The dog slides down the T rail till it r of h hes the stop at the bottom. The tractor weighs about vere th tons in the water, and the amount of trapped buoy- more th is about two tons so that the weight of the tractor, nary c the operators continue to wind down on the drum, is ns, 12 ficient to haul the pontoon to the bottom. The buoyancy in the head of the pontoon also maintains the pontoon in its original vertical position on its way down.

The pontoons are attached to the sides of the ship by means of four large hooks (illustrated), which are placed in the holes already drilled. These hooks are suspended from an internal truss construction, placed just below the center of buoyancy of the pontoon and are individually suspended from adjusting levers modeled after a double tree and whiffle trees. The truss is riveted and welded to the complete periphery of the pontoon, thus distributing the strain and enabling the pontoons to be built of comparatively light material. Before the pontoons are placed in the water the hooks are lashed to the lower lip, so that when the pontoon is advanced to position the hooks hang against the sides of the ship. When the pontoon has been hauled down, the tractor is started and moves up to the side of the ship carrying the pontoon with it just as a locomotive crane in a machine shop can move around carrying heavy weights. A most ingenious device is used to place the hooks in the holes. The tractor can be manoeuvered until the hooks are very close to the holes and then the operators bring into play a pair of thrust rods (illustrated) which extend out from the tractor and which are controlled from within. They are provided with T-heads, which are used to move the hooks laterally and after they have been moved into line of the holes the thrust rods push the hooks forward into the holes. No difficulty was experienced in performing this operation, even though each set of hooks and levers weighs more than a ton. With the hooks in place the pontoon is allowed to rise until the hooks stop its upward motion. The drum is further unwound and the buoy rises to the surface automatically disconnecting itself from the top of the rail. The tractor is then moved out from this position and into line with the next set of holes, when the operation is repeated until all the pontoons are attached.

Before they are hauled down an air hose is attached to the valve in the head of each pontoon. After the pontoons are in place, air is forced down through these pipe lines and the water in the pontoons is displaced. The pontoons are filled in pairs, one pontoon on each side of the ship being filled at the same time. The pairs of pontoons are also filled alternately bow and stern so as to distribute the strain of the lift equally over the whole construction of the ship. The pair of pontoons attached to the center line of the ship are left until the last and before these are filled all surface equipment is removed from over the position of the ship. This pair is manifolded, so that they are filled equally at the same time and as the buoyancy of this pair, taken in conjunction with the buoyancy of all the other pontoons, reaches the point where the deadweight of the ship is overcome, the ship rises to the surface. With the ship afloat the pontoons are lashed fore and aft and transversely across the deck, making them practically an integral part of the ship. Tow lines are

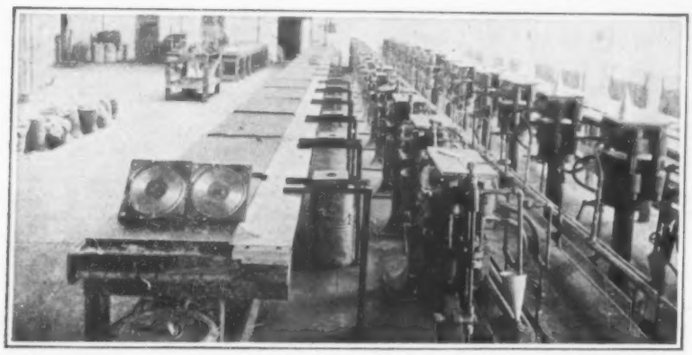
(*Continued on page 216*)



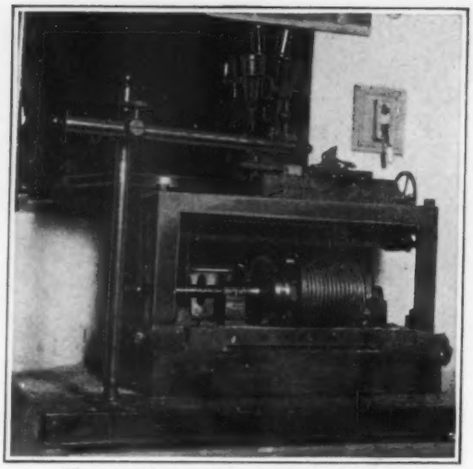
The lifting hooks are engaged in the holes in vessel's side by two T-headed thrust rods operated from within the tractor

Canned Music

Processing the Phonograph Record from the Wax Blank to the Finished Product



The record-pressing room, with the two halves of a die in the foreground



The recording machinery that makes the wax original

FEW industries guard their secrets with greater thoroughness than the phonograph industry. Every maker of records designs his own machinery, lays out his own electrical apparatus, and often uses special automatic machinery of his own invention. Each maker hopes, if he does not allow his feelings to go to the length of actual belief, that he has something better than his competitors. As a result, while the general procedure employed in making these records, identical everywhere, has been put before the readers of this and other journals, photographs have never been published in connection with such an article. Through the kind offices of Mr. A. C. P. Russenn of Newark, N. J., an engineer on machinery for making not only phonograph records but music rolls as well, we are now permitted to glance behind the scenes in the phonograph plant.

The first step in the manufacture of a phonograph record is the making of original wax disks which are about one-half inch larger in diameter than the finished record to be produced, and about three-quarters of an inch thick. These disks are formed by using a fairly soft composition of wax. The original wax disks are placed on the recording machine, which to all purposes is a phonograph except that it is more delicate in construction and that the action of the needle is reversed; that is, instead of the needle falling into a groove, it is forced by the transmitting diaphragm into the soft wax of the plain surface, and plows its own groove.

The recording room, with the artists carefully placed to give exactly the right effect, and the leader beating time

Let us now consider the making of this first impression. The recording room is so arranged that the best results will be obtained. The recording machine is placed in a separate room and only the receiving horns project into the recording room. Special attention is given to the seating arrangements in the recording room. Seats for the orchestra are arranged in a semi-circle. Each chair differs in height to suit the needs of the individual instruments to be played, in order that the air vibrations will be most effective in registering through to the diaphragm on the recorder. In making vocal selections, special attention is given to distance.

The most important factor in the making of records is the first soft wax record or master. The impressions on the wax are very delicate and therefore the record could not be used directly in producing other records. Accordingly, the next step is carried out in what we shall term the electrolytic department. The equipment in this department consists of large rectangular tubs lined with lead and filled with a solution of the same general nature as that used for electrotyping. Suspended from two round brass rods running across these tubs are anodes, usually copper plates. The method of suspension consists of two wires hooked over the rods, making it possible for the entire plate to be submerged in the solution. Parallel with these bars and midway between is another round bar of the same size, on which swivel connections, evenly spaced apart, are located. Suspended vertically from each of these swivels is a small rod with a long end hanging into the solution below the swivel, and a short end above the solution and the swivel. At the ends of these rods in the solution are the wax disks. The object of the above arrangement is to have the disks maintain a continuous pendulum motion in the solution to ensure even plating by keeping the electro-plating bath constantly stirred. This motion is produced by a rod which continuously moves back and forth.

To explain how the small particles of copper are taken from copper plates or anodes and deposited on the wax disks would involve a scientific discussion of great length. It is sufficient to know that the action is due to the electric current plus the chemical action of the solution. The electric current, circulating through the anode bar and anodes, over and across to the wax disks hanging on the swivel arm, carries small particles of copper from the anodes and deposits them on the wax disks with such close adhesion that they pile up in a mass over the face and in the grooves of the wax record.

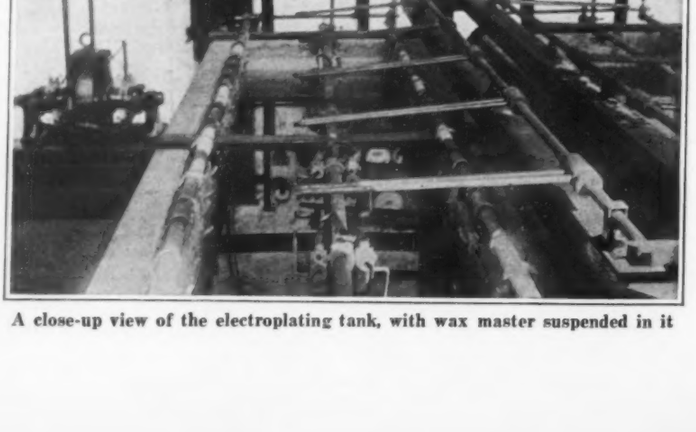
Great care is exercised in keeping up an even, continuous flow of electric current. The humming of the brushes on the commutators of the generators tells the story of good or bad results. After an immersion of 24 hours the wax record is covered with a coating or sheet of copper. The copper sheet is stripped off with the greatest care and the rough edges of the copper disks are trimmed off that portion which projects outside and beyond the diameter of the wax disks. This disk, which is mounted on a stiff metal backing, becomes the master matrix and from it reverse duplicates are produced. This master matrix is a "negative"; that is to say, where the original wax record was depressed, this copper master matrix is raised, and so on. An impression from this matrix, however, becomes a "positive" or right side up.

After coating the back and the edges of the master matrix with wax so that the copper particles will cling only to that part which is not waxed, the master matrix is suspended in the plating solution in the same manner as the original wax disk. After 24 hours the thin deposited copper coat is carefully stripped from the copper face of the master matrix. The new or second copper disk now produced is called the mother matrix, and by treating the mother matrix the same as the master matrix there is produced the third copper matrix, termed the pressing matrix. The pressing matrix is used to press records for the trade. The master matrix is carefully guarded.

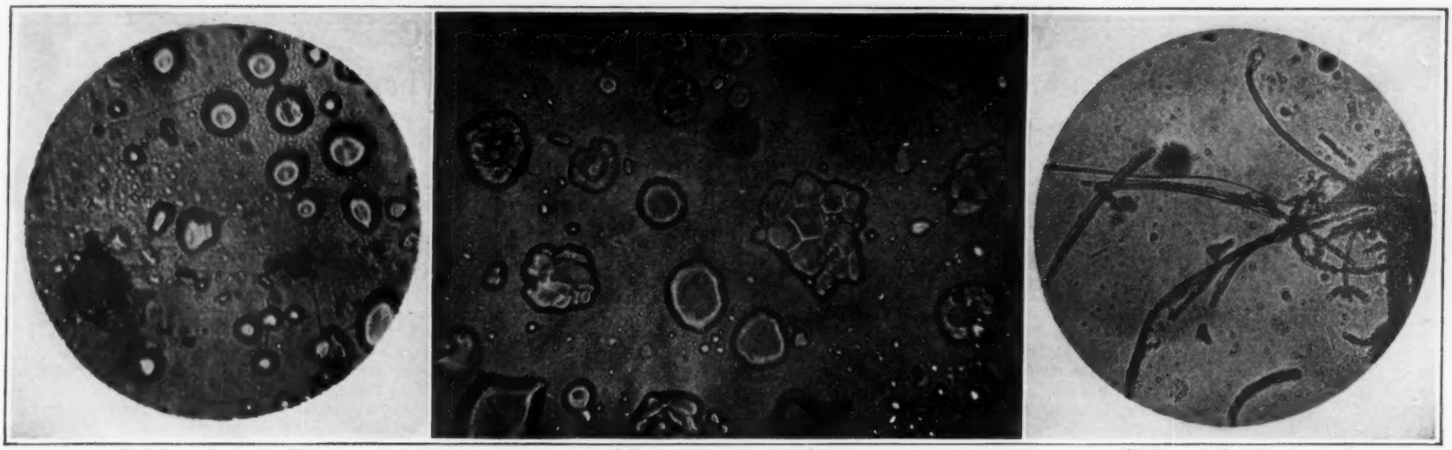
The product, after passing through these various stages of manufacture, is ready for the press room. In this department there is a steam rolling-mill consisting of two or three steam-heated rollers. The composition entering into the finished records consists for the most part of shellac with certain portions of rotten stone and lampblack. These ingredients are carefully pulverized and screened free from metal or other foreign matter. The composition is placed in the hopper and heated, followed by a thorough mixing by the rolls until it attains a consistency somewhat stiffer than bread dough. Care is exercised to get a mixture that will produce a hard, glossy record impervious to slight changes of temperature. Records made from a mixture that is too soft would tend to warp.

The mixture is now flattened out into strips by another set of heated rolls. Rectangular strips about five inches wide and three-sixteenths of an inch thick are cut and sent to the press room. These strips are to be cut into smaller pieces and placed between dies consisting of two square steel plates into the faces of which round depressions have been turned, equal in depth to one-half of the thickness of the finished record plus the thickness of the copper matrix. A separate lipped ring holds the matrix by its outer edge face up, so that when this ring is screwed down the matrix becomes a part of the half-mold.

The complete die—mold plus matrix—is placed in the hydraulic press, the dies being warm and the stock pliable. As the two half dies are pressed together, the lump of stock is flattened until it flows to fill the entire opening plus a little that overflows, the latter forming a slight fin around the outside edge of the record midway of its thickness. Each record is subjected to from 10,000 to 20,000 pounds total pressure. The finished record is placed in a trimming lathe and the fin or overflow shaped off. After this process the record is tested on an ordinary phonograph. After testing and packing the records are ready to go forth to the trade and the large and ever-growing public.



A close-up view of the electroplating tank, with wax master suspended in it



Rust drops that seem alive | Cell growth in rust vegetation | Further samples of rust growth

Photomicrographs showing characteristics of growth possessed by iron rust, as brought out by a recent German investigation

How Iron Rust Grows

By Dr. A. Gradenwitz

THE rust problem, on account of its enormous importance in engineering practice, has been the subject of an extraordinary number of investigations. Still, the innermost mechanism of the process had so far escaped the attention of both scientists and engineers until Dr. Adolph Ackermann, of Berlin, studied this side of the problem from a decidedly new point of view.

All methods so far used in this connection invariably examined aqueous solutions of the most varied sorts and concentrations with a view to ascertaining their influence on the rusting process under the most varied physical conditions. But in such investigation the solvent was always present in excess. Dr. Ackermann, however, worked with a minimum of solvent, using gaseous solutions from which minimal—in fact microscopic—amounts of solvent would be precipitated on the iron particles to be examined. The forms and processes observed in this connection are not only of interest for the rust problems, but would seem to have a general chemical and physical and even a biological bearing.

The method devised by Dr. Ackermann can be carried out with any microscope. When reducing the interacting forces to a minimum and only allowing the amount of water vapor actually required for starting the rusting process to act upon the iron, the microscope is bound to reveal the first and most transient alterations occurring in the shape of the iron. Having therefore spread out some iron filings on a glass plate, by means of a glass needle or the like he applied a minute drop of diluted acid, covering the whole with a glued cover glass and thus placing the iron particles in an atmosphere of water vapor from which a precipitate of iron hydroxide would separate in the most various forms. The most striking phenomena would occur at a temperature of about 15 degrees centigrade, the maximum admissible temperature being 17 degrees and the minimum temperature below which these phenomena ceased to occur, 12 degrees centigrade.

The forms and morphological processes thus observed in connection with ferrous hydroxide show striking analogies with phenomena which occur in organic nature. Flexible threads are produced, growing like organic fibers, shifting and moving about under external stimuli (variations of temperature). In fact, even cell systems corresponding in external form and arrangement to organic cell threads are produced under certain conditions. Moreover, microscopic drops of ferrous hydroxide dissolved in water show characteristics otherwise only observed in the case of organic cells, exhibiting a solid or half-solid membrane, an adjoining colloidal layer and a vacuole or nucleus. These minute drops will grow, spread out and divide in exactly the same manner as organic cells by simultaneously rising partitions or transversal membranes Though data so far available are not sufficient to ascertain whether these analogies are only external morphological phenomena or are due to an intimate agreement with organic processes, the evidence obtained by Dr. Ackermann would seem to warrant a closer investigation of the case by workers in the biological field. A critical comparison should, for instance, be made between the threads and fibers of ferrous hydroxide, on the one hand, and those well known micro-organisms known as iron bacteria, on the other. In fact, these bacteria, which in connection with rust deposits are often observed in water supply pipes, show, from the point of view both of material and of form, remarkable analogies with the cell threads observed by Dr. Ackermann. There is only one striking difference; iron bacteria exclusively live in water, whereas these cell threads are immediately dissolved by water. However, the question arises in this connection, whether the morphological forces which in both cases and out of the same material show such a striking similarity of forms, are not in some way related to one another, the plasma in the case of iron bacteria possibly preventing the colloidal ferrous hydroxide from being dissolved by the water. Quite apart from a multitude of special problems connected with iron bacteria and which are likely to be solved in the light of Dr. Ackermann's investigations, the analogy of these strange forms with organic cells, on the one hand, and with Lehmann's liquid crystals, on the other, are so remarkable that there has possibly been found a new link in the chain connecting the inorganic and organic worlds.

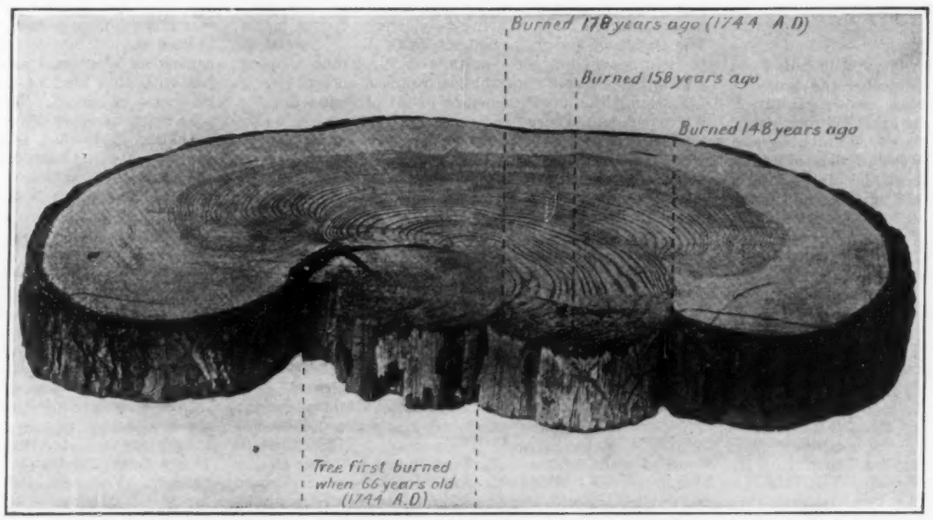
Problems Relating to Saggars

SAGGARS are containers employed in manufactories of chinaware for holding plates, cups, saucers, etc., during the firing in the kiln. These containers are made of clay which must have considerable strength and be of good refractory quality. The Bureau of Standards is conducting a thorough investigation involving a geographical study of saggar clays to classify them according to their properties, and finally to see what may be done toward increasing the life of the saggar. So far as can be judged from the information obtained, about 90 different clays, or rather clays sold under approximately 90 different names, are being used for saggars in the United States. Samples of 52 different clays, representing as well as could be judged all the important types, have been sent for and many of them have already reached the laboratory. These are being obtained in 200-pound lots from the users rather than from producers or dealers in order to eliminate uncertainties as to whether samples are representative of the commercial output of the mines or pits. Manufacturers are contributing these rather large samples from their stocks and prepaying the freight to Washington. This illustrates the wholehearted manner in which industries are responding to the bureau's calls for assistance and real cooperation in its investigations.

In order to classify the saggar clays according to their properties, they are being subjected to the following tests: Water of plasticity, shrinkage, porosity, transverse strength, and burning behavior at five different cones. Some work has been done upon all the clays received and in getting this work under way considerable attention has been given to details of test methods.

How a Tree Tells the Story of Forest Fires

OLD blazes and forest burns tell of ages of trees with almost absolute accuracy. They always leave scars from which the forester or experienced woodsman can count the annual growth of the tree to some later scar on to the present time. It is thus from the trees left standing which were only partially burned that the exact dates of great forest fires in the long distant past have been ascertained or verified. The photograph shows a section of a pine tree which has braved these forest fires, one of them 178 years ago, in 1744, when the tree was 66 years old. The next damage was 158 years ago and the last burn was 148 years ago. These three burns have left a dead side to the tree and have forced the growth to the opposite side, but two big lobes partially encircled the dead portion. In very old trees there will always have been some years of great drouth or "famine" among the tree kind when the year's growth is almost nothing so that it is frequently necessary to use a microscope to determine a ring of growth. The photograph and count of the rings of this tree were made by the Commission of Conservation of Canada.



Cross section of a tree 244 years old, which gives an accurate record of the forest fires to which it has been exposed

When We Paint Our House

Some Observations About the Paint We Shall Use and What Goes Into It

By Ismar Ginsburg

WE LIVE in a world of color. All around us, the skies, the trees, the flowers, the birds of the air and the beasts of the field, the minerals in the earth, all possess distinctive colors. It was not strange that prehistoric man sought to imitate the colors he saw in nature, by mixing colored earths with a little water and smearing the mixture—probably the first type of paint made—over his face and body. The next step was to mix these pigments or colors with fat or grease, which gave a more lasting coating, to be removed only by thorough washing. From painting his own body, the prehistoric man derived the idea of painting his possessions, the skins that he tanned, the crude clothing that he wore and the dwellings in which he lived. At first his thought was to decorate, to color gaudily, but then he discovered that painting the leather shield, the wooden canoe or even the body itself served to protect it against the weather and other influences causing wear and tear.

At this point the real history of paint commences. The use of oil for mixing the pigments was a natural development from the common application of the oil in anointing the body as a protection against the weather. The first historical reference is of Egyptian origin, and is concerned with varnish instead of paint, which was used on the wooden mummy cases. These varnished cases, at least 2500 years old, can be seen in the museums. All ancient peoples used some forms of varnish, and the surprsing fact is that these varnishes were so well made as to last for 25 centuries in remarkably good condition. From making and using varnish the next step was to make paint, as we know it today. By the thirteenth century, during the reign of Edward I in England, such a thing as a painter's bill was known. From that point on the development in paint making and use has been continuous until today the paint industry may be said to be one of the most highly specialized of all human endeavor.

Varnish is the logical predecessor of paint. In a varnish there are four distinct constituents, the vehicle, the thinner, the drier and the resin or gum. In a paint we find similarly the vehicle, the thinner, the drier, and instead of the resin, the pigment. A varnish can be made into a varnish-paint or enamel by simply mixing a certain amount of pigment or coloring matter with the former. The natural color of varnish is amber, and it is interesting to learn that the name, varnish, is derived from the name of a beautiful Grecian woman, first Queen of the Macedonians, known as Berenice, whose hair was amber in color.

The Vehicle

In both paint and varnish there is what is called the vehicle. This is an oil which possesses the property of drying or hardening and being converted into a solid substance on exposure to the air. The quality of the paint or varnish, its ability to withstand wear and tear and the influences of the weather depend to an important measure on the nature of the oil used as a vehicle. The first oil used for this purpose, and up to the present day still the best and most popular is linseed oil. This oil is extracted from the seeds of the flax plant, that wonderful plant, which produces both a most valuable oil and a highly prized textile fiber, linen. With the usual irony of nature, this plant must be grown either to produce good linseed oil or good linen, both conditions being impossible of attainment at one and the same time.

Linseed oil, and the other drying oils, which have come into general use during the past decade or so, such as China wood oil or tung oil, all absorb oxygen from the air and change from the liquid into the solid condition. In doing so they form a continuous film, which binds together the various constituents of the paint or varnish, holding together in a fast, homogeneous union the fine particles of the pigment. The tenacity of this film of oil, which is a mere fraction of an inch in thickness, its resistance to wearing influences of all kinds, are what determine how long the paint will stick to the surface to which it has been applied. Linseed oil produces films which give the best results. For certain purposes the other oils, mentioned above, may be used, and a certain proportion of them in admixture with linseed oil is permissible. However, it must be remembered that whatever is added to the paint to take the place of part of the linseed oil will surely detract from the wearing of the paint, and that while a certain amount can be added without any bad effects, too great a proportion will spoil the paint. A paint which does not contain the proper amount of a good grade of linseed oil or other drying oil will tend to peel off the surface, rather soon after it has been applied thereto. The linseed oil that is bought on the market is frequently adulterated with other oils, which detract from its quality and produce bad paints. The more important of these adulterants are mineral oil, benzine, turpentine, rosin oil (also rosin itself), menhaden oil and other fish oils, and various non-drying vegetable oils, such as cotton seed oil, corn oil, etc. These oils are all generally cheaper than linseed oil. There is just one way of telling the quality of linseed oil, and that is by accurate chemical analysis.

The Pigment

The pigment gives color to the paint. It is either mineral matter or organic dyestuffs. By far the greatest proportion of pigments used in paint making are mineral in origin, used either in the form in which they are found in the earth, or else first purified or manufactured by complicated chemical processes into other pigments. The quality of the pigment is also important in determining the wearing properties of the paint. The choice of the proper pigments is also essential to the attainment of good results with the paint. A poor pigment just like a poor vehicle means a poor paint.

Probably the most important of all pigments are the white colors. There were just three of these white pigments in general use up to rather recently. These were white lead and the different forms of white lead substitutes, zinc white and lithopone, which is a mixture of zinc sulfide and barium sulfate. Another white pigment has been added to the list. This is called titanium white, and is an oxide of titanium. The manufacture and use of titanium white is a European development, having been given particular attention in Norway, France and several other continental countries. It is claimed that the pigment is superior in many ways to the other white pigments.

Poisoning by Lead

White lead is still the most important pigment used in the manufacture of paints. It was known as far back as the fifteenth century, according to a manuscript found in Bologna, Italy. The best quality of white lead is made by the slow process, known also as the Dutch process. The time consumed in the manufacture in accordance with the Dutch process is really considerable, and hence the cost of the pigment is correspondingly high. There are a number of other processes of making white lead, in which the time element is reduced in a large measure, but it is the consensus of opinion that the pigments, produced by the shorter processes, are not as good as that produced by the Dutch process. This process consists simply in allowing the fumes from dilute acetic acid or vinegar to act on bars of lead, placed in earthenware pots, buried in tan-bark, which ferments, producing heat and carbon dioxide.

Much has been said about the poisonous qualities of white lead and the paints made from it. Recently, the labor circles of France and other European countries have been much concerned about this question, and in the recent meeting of the International Labor Congress at Geneva a resolution was passed barring the use of white lead in paints. It was pointed out that these paints are very poisonous and that the white lead pigment can be replaced to good advantage by other white pigments, and particularly by the new pigment, titanium white, which was developed commercially in Norway. It was claimed that this pigment is even better in covering power than white lead.

There has been a great deal of uncalled-for propaganda against the use of white lead because of its poisonous properties. It is of course true that white lead is poisonous, but so are a great many other substances which are in common daily use. If just the ordinary care is taken with paint, whether it contains white lead or not, there need be no fear of any poisonous or other deleterious effects on the system. Cleanliness is essential, and if the ordinary rules of hygiene are followed, for example, if the hands are washed before eating, after handling white lead paint, the painter will not be poisoned. Prohibition of the use of white lead because some painters are not cleanly and are prone to practices which promote the assimilation of white lead into their systems is not only unjust but savors of catering to special interests.

We have already mentioned the important white pigments. There are numerous colored pigments, most of which are of mineral origin, as has been mentioned before. The principal yellow pigments are cadmium yellow and chrome yellow. Good yellow paint is always made with one or the other of these pigments. Chrome green is the best green pigment. Paints made with Paris green are not very satisfactory. Most blue paints contain Prussian or Chinese blue or ultramarine. The most important red pigments are the iron oxides, the ochres and umbers. Their colors are not very striking, but they are cheap and while not absolutely permanent, they give valuable paints. Vermilion gives a very brilliant red paint. A large number of fine reds are made from organic dyes, some of which are very fast to light, but most of which do not possess great hiding power. Red lead is the pigment that is used in making red paint for coating iron and steel. Almost all structural steel work now-a-days is painted red with this kind of paint. The black pigments are all forms of carbon. The most important varieties are bone-black or ivory black, lampblack, carbon black and graphite. Bone-black is made by calcining bones in the absence of air. Lampblack is made by burning oil in the absence of sufficient air for complete combustion, while carbon black is manufactured in the same manner, natural gas being used in the place of oil. Graphite is a natural mineral.

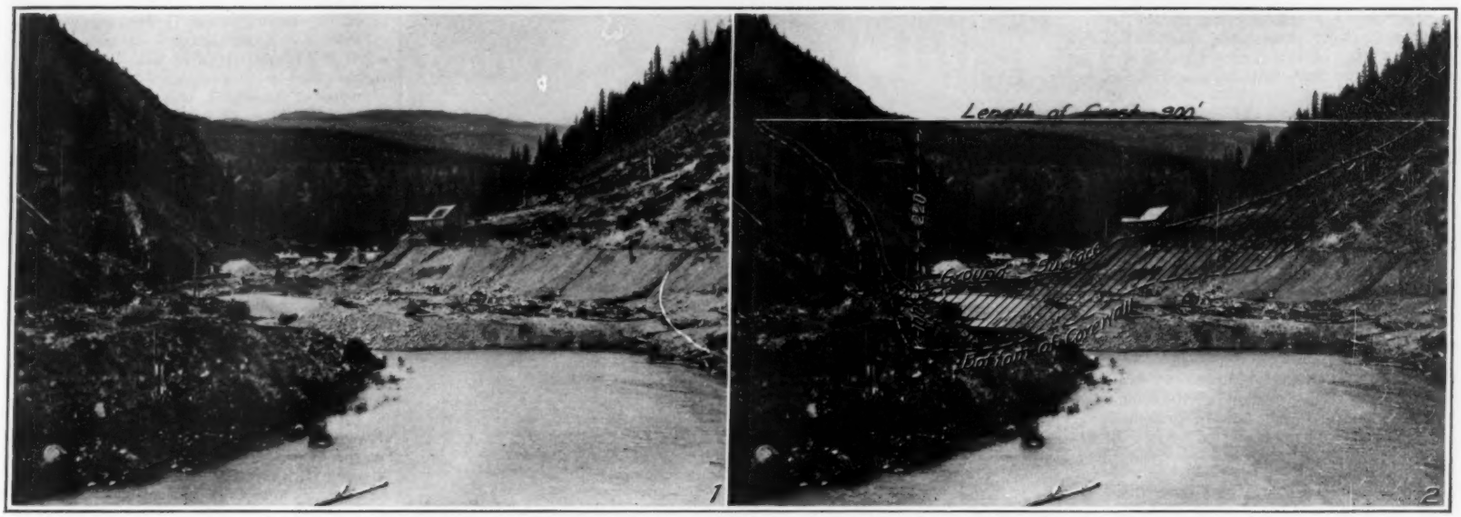
The Thinner

We have described the vehicle and the pigment, those two constituents of a paint which determine its quality, the longevity of coatings made with it and the ability that it possesses of covering and protecting surface and hiding the original color of the same. There is still another important constituent of paint, which is added merely for the assistance that it renders in the application of the paint, and that is the thinner. Paints made just with pigment and oil will not flow freely from the brush; they must be diluted with a thinner. The best thinner is oil of turpentine, but many other solvents, derived from petroleum or coal tar, are used, such as benzine, benzol, naphtha, etc.

(*Continued on page 216*)

EVERY householder knows the paint problem as an ever-present care. Every householder has realized that paint presents two entirely independent aspects: that of color, and that of protection. Every householder knows that sometimes paint gives good service and that sometimes it doesn't. Every householder, even, knows a little about the composition of paint—he knows that linseed oil, and turpentine, and white lead, and a few other things whose names are more or less familiar to him if their properties are not, go into the paint that goes on his porch, his roof, and his clapboards.

Every householder would profit by greater knowledge of paints, paint structure, painting technique, and painting technology. The present article, of course, is not exhaustive of a subject which could be strung out into a very fat book without any waste of space; but it contains much that should be of interest and value to the householder, and to anybody else who has to do, in a lay capacity, with paints. It affords an admirable supplement to Professor Record's more general article on house-building, in our February issue.—THE EDITOR.



The untouched site of the Tieton Dam, and the place which the finished structure will occupy in the gorge

Digging from Below, Up

A Dam-Construction Problem Involving a Deep and Narrow Trench in Treacherous Ground

By J. F. Springer

IN the State of Washington, the most northern of the Pacific Coast States, the Cascade Mountains divide the country into two slopes. Both the eastern and western, however, drain into the Pacific Ocean. However, the Cascade Mountains succeed in withdrawing from the prevailing westerly winds much of their moisture, so that as a result the land on the east suffers more or less from a diminished supply of water. The problem is then presented of storing the water carried by certain mountain streams and using it at the most opportune times. The Tieton River is a stream formed by the junction of two forks which include Tieton Peak between them. At a point on this river, 26 miles from the nearest railroad station at Naches and in the Mount Ranier National Forest, a considerable storage dam is being constructed. Mount Rainier itself is not far distant, but its ice cap, 14,526 feet above the sea, is really on the west side of the Cascades and further to the north.

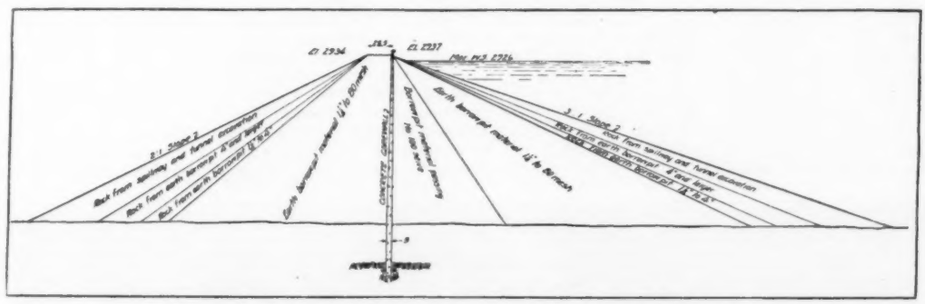
The height of the dam above the lowest surface point of the site will be 220 feet. But the foundation or lowest part of the structure reaches down 100 feet below the bottom of the canyon. In consequence, from the under surface of the core wall to the crest of the dam will be about 320 feet. The length of the dam along the crest will be 900 feet.

There are some noteworthy features about this dam. One is the core wall which will be a solid concrete structure standing on bed-rock underneath the dam and rising three feet above the crest. It will stand in a trench which cuts across the canyon. The bottom of this trench varies from point to point. Roughly, it follows the V of the canyon; but, as already indicated, it dips down 100 feet below the canyon surface. The method of excavating the rock and earth and the mode of filling in the concrete in the subsurface part are both notable. A second feature associated with the work is the dam itself. This will be an earth-and-rock structure. A typical section shows the base with a width of about five times the height. That is to say, the upstream slope has an inclination determined as 1 on 3 and the downstream slope an inclination of 1 on 2. The angles of the two slopes may readily be ascertained from a trigonometric table of natural tangents by noting the angles corresponding to 0.3333 and 0.5000. The result of piling earth and rock in this manner is to provide an obstruction of the nature of a natural ridge or hill, with broad base and sloping sides. There are several varieties of such dams. Those in which the filling consists largely of fine material which is pumped into place constitute one variety. The Gatun Dam at Panama is perhaps the most notable instance. The present Tieton Dam will be another. Then there is the rock-fill dam which is a new variety and is being developed in the West. The oldest of all is the dam filled with earth and perhaps a certain amount of rock.

This type of dam is quite old. Such structures have been constructed in India and Ceylon from very ancient times. In the Madras Presidency in India there are some 53,000 such dams having a total length of 30,000 miles. However, the conditions at the site of Tieton Dam are severe and the design is quite modern.

The concrete core wall has a thickness of five feet in the subsurface portion. Above the surface the wall will taper to a thickness of one foot at the top. No reinforcement goes into the trench portion; but a good deal of reinforcement is demanded for the upper part. Although this structure is 900 feet long, there are no expansion joints.

The excavation of the trench is really a remarkable piece of work. This affair is, as already indicated, five feet wide and 900 long. The depth varies from five feet on the west side to 100 feet at the bottom of the canyon and to 35 feet at the eastern end. There is a great deal of the length that is quite deep. The problem of excavating it is a considerable one. The very fact of going to such depths is to be interpreted as meaning unreliable rock. In other words, the trench could not simply be dug and no severe attention paid to the maintenance of the side walls. By the use of timber or steel sheet piling and of much bracing it is possible that the work could be done. But 100 feet is quite a height of side wall to maintain. An entirely different method has been adopted.


El. 1934
El. 1737
Max. W.S. 1716
Concrete core wall
Earth, borrow pit material if it is thrown
Earth, borrow pit material if it is thrown
Rock from stairway and tunnel excavation
Rock from earth borrow pit "B"
Rock from earth borrow pit "A"
Rock from stairway and tunnel excavation
Rock from earth borrow pit "B"
Rock from earth borrow pit "A"

Typical section of the Tieton Dam, according to the plans of the engineers

The procedure borrows something from the method of mining known as stoping. In the present case, the following plan is being followed. Three principal shafts are sunk down through the soil and rock to bed-rock. At the bottom of each shaft an excavation known as a sump is provided as a catch-basin from which all water which would otherwise obstruct excavation may be pumped. Suitable pumps are installed and put to work. Horizontal or approximately horizontal excavations are made from the shaft at two diametrically opposite points. These follow the line of the trench and are called drifts. The drifts are made six feet high and of the full width of the desired trench, five feet. Nowhere is such a drift made less than five feet deep, and the depth runs up to as much as 30 feet. The point forever in mind for the bottom of the trench is that the core wall should have absolutely reliable bed-rock under it. In the case of any shaft, the lower drift will after a time be completed. The next step is to excavate a second drift higher up. This will form a kind of second story. Enough material is left in place to form the floor of one drift and the ceiling of the other. Mine cars are used in the lower drift to run to and from the shaft. The "spoil," as the material obtained by excavating is called, is run down to the cars through holes cut through the roof of the lower drift. This material is taken to the shaft and then hoisted out and dumped. The shovel is scarcely needed for the upper drifts, as these are constructed at higher and higher levels. When two drifts, one above the other, have been completed to the proper points, the lower one is filled up with concrete, and this much of the core wall is finished and in place. This concrete is placed by means of cars which run on tracks in the upper drift. The procedure of excavating a higher drift, dropping the spoil through holes in the floor and later concreting the drift below is now repeated. In this way the core wall is put in a portion at a time. The base of the wall is thus in place before the excavation is made for the upper part. In fact, the excavation is made from below up and the concrete follows in due course. The foregoing is the plan. As to how the plan is working in the process of being carried out, one may note what one of the construction engineers of the United States Reclamation Service says: "Considerable loose and swelling ground is being encountered, together with large quantities of water, and the work is very difficult in the section immediately

below the river. However, the method is working out very satisfactorily and is the only one thought practicable, considering the deep excavations required and the nature of the material encountered, as it would be almost impossible to shore up an open trench to such extreme depths."

The embankment is to be a hydraulic fill blanketed with a triple layer of rock. That is to say, there will be the great core wall reaching down to and into bed-rock and rising to a level a little above the crest. Then there will be the earth fill put in on each side to form an embankment. These embankments will have steeper slopes than those of the finished dam, since the triple rock layers are much thicker at the base than at and near the crest. Such a dam is quite a modern affair and differs doubtless very much from the ancient embankment dams still existent in the India-Ceylon regions. The precise interior design of these archaic affairs is probably largely a matter of conjecture. That they have survived is testimony to the character of the conceptions put into effect. In Ceylon there is a reservoir or tank having a circumference of some 40 miles dating from A. D. 459. This tank is formed by an embankment 12 miles in length. The spillway was of stone. Then there is the Cauvery-pauk Tank which has been in service some four or five centuries. The embankment is 3¾ miles long and is revetted on the water side by a stone wall and protected on the dry side by turf. But there is probably no core wall and apparently none has been needed. However, at the site in Washington the conditions are very severe.

To fill in the great embankment is a considerable job. Two borrow pits, one above and one below the dam, are to furnish the bulk of the material. The pit above will be the one put under the greater demand, because it is on this side of the great core that the gentler slope is to be, and therefore the larger amount of material. A 100-ton electric shovel is the dependence here and a smaller shovel at the other pit, this one being operated by compressed air. Narrow gage railways will supply the means of transportation. No less than eight steam locomotives and 75 dump cars are to be used in this work. The tracks from the pits must deliver material up to various levels, because of the sloping faces of the dam. The plan is to bring the tracks on to the two slopes on trestles whose elevations will increase in steps of about 30 feet. The material will be dumped from the trestles and then operated upon by hydraulic giants. There will thus be formed a kind of central pool with the core wall dividing it into two parts. A pump is to be located in that part of the pool that is on the downstream side of the core wall. Its duty will be centered on a pumping mixture of clay and water to the upper side of the wall with the object of there constructing a bank of clay against the upstream side. The removal of clay from the downstream side will result in leaving an excess of sand. The plan contemplates, next the upstream face of the core wall, a bank wide at the bottom and narrowing to nothing near the summit of the wall. This material is to consist of grains that will pass a 100-mesh sieve. The idea is to shut the water off from what is the equivalent of a big dam consisting of the core wall and this embankment back of it. This structure is then a kind of inner dam. The remainder of the earthy material on the upstream side is to consist of grains and lumps running from 1¼-inch size to 80-mesh. Similar material is to form the downstream earthy embankment. When these embankments of earthy material are properly in place, their blankets or protective coverings of rocky material are to be laid on. Each consists of three layers, the steeper blanket layers on the downstream face being perhaps heavier than their counterparts on the upstream face.

But some dams need protection against water flowing over their crests, particularly dams of this type. So then a spillway is necessary to permit the excess water to pass. This part of the great dam will be constructed in the rock on the western, or steeper, side of the canyon. The overflow lip will have a length of 420 feet and there will be six drum gates, 65 feet long and 8 feet high. Under normal conditions, the capacity of the spillway will be sufficient to pass 30,000 cubic feet of water per second. But, if the water rises to exceptional heights and threatens to overtop the main dam, then the capacity will rise to 50,000 second-feet. The discharge of this spillway will be through a concrete conduit down the steep side of the canyon into a pool well removed from the downstream toe of the dam.

When this dam goes into service, it will impound a large body of water which will be held in a reservoir to supply the dependent district with a fair supply at the times desired.

This church, weighing 3200 tons, was raised from its foundation and moved back 20 feet, without a crack appearing in the wall paintings or mosaics, and without interruption of the services

Measuring the Tractor's Performance

TO measure the efficiency of the tractor under actual working conditions is the purpose of a box-like device known as the hydraulic dynamometer. This measures draw-bar pull, depth of furrow, etc., recording these facts on a drum of paper. There is an oil cylinder at one end of the draw-bar connecting tractor and plow. The pressure in this cylinder is proportional to the pull. This pressure is carried to the recording drum through an armored tube. The drum is revolved by connection to a wheel trailed over the ground. Time check marks are made on the paper at regular intervals and there are other check marks for the revolutions of the two rear wheels of the tractor so that any wheel slippage is recorded. Two other pencils record the exact depth of plowing of the two outside bottoms. This is accomplished by means of curved steel rods trailing on the ground alongside of the bottoms, bent to form bell cranks which connect with the two pencils.

Moving a Church of 3200 Tons

THE American house-mover is justly celebrated for some of the extraordinary feats which he has accomplished. Yet it is a fact that such difficult jobs as that shown in our illustrations do not excite in us the wonderment which is felt in other parts of the world. That is because we have always had the house-mover with us; and in the earlier days of our history, when so large a proportion of the buildings were of wood, it was a comparatively simple matter to jack up a house from its foundations and roll it across the street, or through the full length of the street for that matter, to its new site.

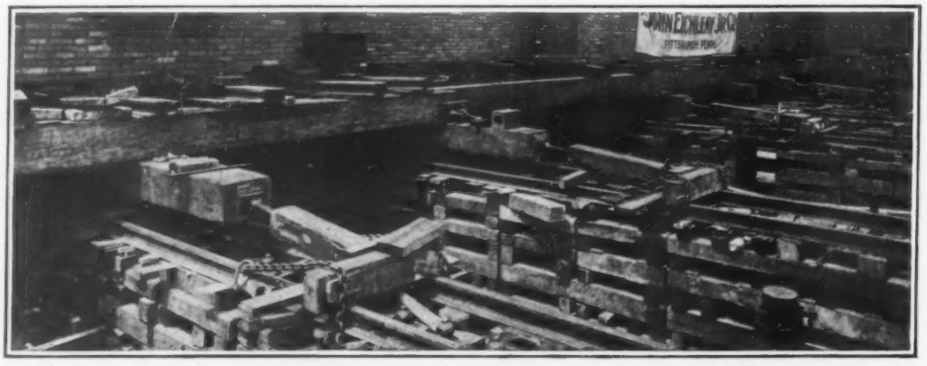
Of late years the art of house-moving has developed to the point where a good firm does not hesitate to move buildings whose heights run into many stories, and weights to several thousand tons. The building shown in our illustrations is the Roman Catholic Church of St. Nicholas, situated on East Ohio Street, Pittsburgh, Pa. It became necessary to move the building back from its original foundations, and since it abutted against a steep hillside, the contractor was first obliged to excavate about 3000 cubic yards of earth before the structure could be moved the desired 20 feet. The church is built entirely of brick and has no framework of any kind. It measures 110 feet in length by 65 feet in width, and it will be noted that there are heavy towers flanking the front entrance. The weight of the roof is carried by the outside walls, and by eight columns, four on each side of the nave, in the interior. The altar, the sacristy, and the walls and arches of the church are richly decorated, and the windows are filled with art glass. When we bear in mind that the weight of the building is 3200 tons, and that this load had to be moved without any cracking of the walls, or any defacement of the decorations, it will be understood that here was a task calling for a very nice adjustment of the building upon the heavy cribwork upon which it was moved.

The first job was to transfer the weight of the building from its foundations to 12 "running timbers," each measuring 14"x16" in section. These main timbers carried other cross timbers, also measuring 14"x16", and upon these were placed groups of 8" steel I-beams upon which the load of the brick walls rested directly. The groups of I-beams were spaced about 3' center to center.

When this transfer of the load was completed, the building was raised bodily through a height of 8' 6" by means of several hundred jacks, placed under the 14"x16" "running timbers," twelve lines of cribbing built up of 6"x8" timbers being carried up under the whole structure as the lift proceeded. When the church had been lifted through the full height, 85-pound steel rails were laid in pairs upon the lines of cribbing. Upon the rails were placed nests of 3" steel rollers, and between the rollers and the timbers were arranged half-inch steel bearing plates, and 4-inch oak packing pieces. The lifting jacks were then released and the load of the building was taken by the rollers and steel rails. The moving of the church 20 feet back from its original position was done by ten jacks, which bore against the ends of the "running timbers," the foot of the jacks pressing against a short length of timber, which was anchored by chains to the rails, as illustrated. The jacks were operated by hand, and the church was moved to its new position in eighteen hours' time.

The building was then transferred to vertical jacks, and the final accurate leveling was done by the engineers. Then the new walls were built up on the new site, the structure was under-pinned, and the "running timbers," jacks, etc., were removed. The work was done without any cracking or other damage.

In view of the difficulty of the work, it would have been the natural thing to close the church during these operations; but such was the confidence of the contractors and the clergy that the doors of St. Nicholas remained continually open. There was no interruption in the use of the building, the lighting, heating, and sanitary conveniences being maintained, and the services carried on as usual. We are indebted to John Eichleay, Jr., who carried out the work, for the photographs and details which are here presented.



This shows the cribbing on which the church pictured above was supported, and the steel rails and screw-jacks by means of which it was pushed back to its new position

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

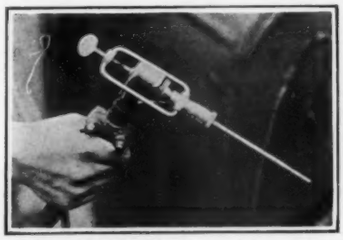
Cooking four dishes over a fire that would ordinarily serve for only one

The Four-Story Saucepan

DURING the past five years there has been extraordinary inventive activity in Germany, in the direction of household economies and utilities. Throughout this period the average German household has been in pretty sore straits to make both ends meet, and has been driven to every possible expedient for saving. And not alone have German inventors cooperated with German housewives in the most obvious economies of the home, but they have gone further, and given the housewife real technical aid in effecting economies that are not usually attempted on a domestic scale.

Take the matter of fuel, for instance. There is a difference between prudent and extravagant use of fuel which every good housewife knows; but after she has once achieved that difference, it is seldom indeed that she ever goes further, and attempts the scientific utilization of every last calory of the potential fuel value of her fire. But in Germany today, fuels of all sorts are among the things that have scored the most calamitous rise in price. Accordingly it has become very much the thing for the German home to be equipped with stoves and cooking utensils that represent the last word in the endeavor to make two heat units work where, before, one worked and one went to waste.

The four-story steaming vessel of which we present two views—one assembled in use, and one dismantled to show construction—is a case in point. With the heat which would ordinarily be devoted to cooking the contents of a single vessel, plus that which would ordinarily escape into the atmosphere around the sides of such vessel, the contents of the three lower receptacles are cooked, while in the upper one enough temperature is still left to bring water almost to a boil. The fundamental extravagance, not so much of our stoves as of our way of applying their heat to our cooking utensils, is admirably illustrated by the success of this simple assembly in doing what is claimed for it.

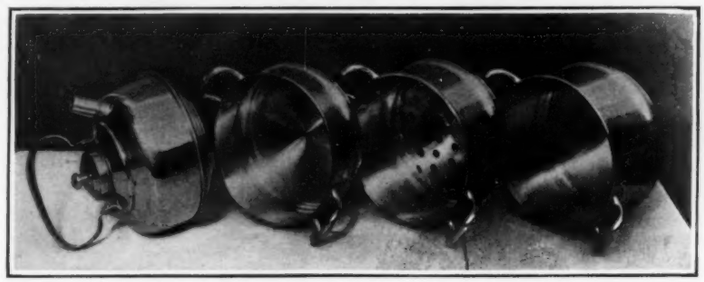


Nozzle with double jet, used for cleaning automobile engines with a blast of kerosene and air

Utilization of Gas

IN connection with the convention of the American Gas Association held at Atlantic City during the week of October 23, the Bureau of Standards had an exhibit which attracted a great deal of attention. In this exhibit the principal gas publications of the Bureau were shown as well as other publications that might be of interest to gas engineers. A demonstration illustrating the results of improvements in burner design appeared to excite special interest. In this connection an ordinary burner and beside it one of improved design were shown. The burner testing apparatus of the Bureau was also on exhibit and frequent demonstrations were made showing the operation of burners under various conditions. The value of this apparatus, which has been developed at the Bureau of Standards, was so apparent that the utilization department of one of the largest gas companies recently had two of their engineers visit the laboratories to investigate in more detail the operation of the apparatus with a view to installing similar equipment in the laboratory of the gas company.

It is believed that the exhibit served greatly to increase interest in the Bureau's work on the better utilization of gas, and a number of appliance manufacturers have expressed their desire to assist the Bureau in every way possible. Over 60 manufacturers and engineers have been supplied with publications dealing with gas appliances.



The structural arrangements of the four-story saucepan

Blowing Dirty Engines Clean

A DEVICE for cleaning grease, oil and dust from automobile motors or other sorts of machinery has been recently developed by a Chicago manufacturer. The device consists of a nozzle with a double jet and in use is attached to the tire air-chuck on the compressed air line and the kerosene hose is placed in a can of kerosene. By screwing up the thumb nut on the air-chuck line the air is released and the kerosene is sucked up. The cleaner operates on the injector principle and a powerful spray of kerosene is thrown against the motor and quickly cleans off all the dirt and grease. By turning the knurled ring where the spout joins the cleaner body the flow of kerosene is regulated. After the motor surface is cleaned the kerosene is shut off and the motor is then dried with the air. The air is shut off by releasing the thumb nut.

Automatic Insertion of Carbon Sheets

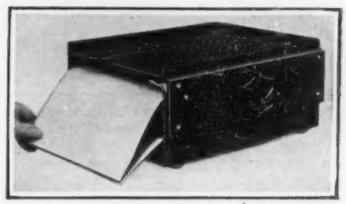
A MACHINE developed by a New York man assembles by mechanical means the papers and carbons used by a typist in writing letters and effects a great saving in time and labor. The device is a cabinet of pressed steel having a number of compartments for containing supplies of paper and carbon sheets. By operating a lever the paper and carbon sheets are fed out of the compartments and collated in proper order ready for insertion in the typewriter. After typing the carbons are deposited on a cardboard tray under a hinged cover on top of the cabinet. When a supply of carbons in a compartment is exhausted the empty tray is exchanged for a full one. This arrangement equalizes the wear on the carbons as the top sheet of a pile of carbons in a compartment will be the bottom sheet the next time the compartment is refilled.

An Artificial Stomach of Glass

AN instrument made to simulate the action of the stomach in combination with the proper chemicals is being tested by the Department of Agriculture. The proteins to be tested, those from beans, for example, are placed in glass containers in a dilute solution of hydrochloric acid. The proper quantity of pepsin is added, and the mixture is placed in a heater where the temperature is kept at the same point as that of the human stomach. After a number of hours the contents of the container are analyzed. The digestive effect is measured by the ratio of what is known as amino-nitrogen to total nitrogen. By running through cooked and uncooked protein from beans it is possible to determine which is more easily acted upon by the chemicals, and consequently by the stomach itself. After the food has been acted upon by the pepsin and hydrochloric acid, it is treated with trypsin and a dilute alkaline solution, as nearly as possible like the digestive juices found in the small intestine. This second process tells the investigator what the probable digestive action of any particular food will be in the intestines.

Radio for the Plant Telephone System

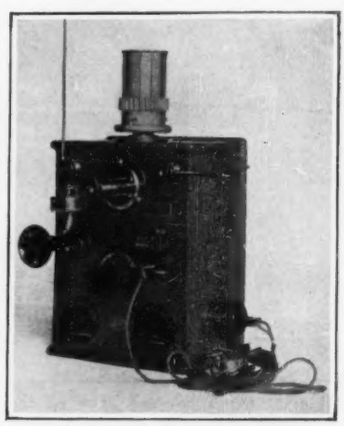
TO most of us the word "telephone" has but the one connotation — the public service system that spreads its network of wires throughout the city and makes it possible for us to sit at our desks and do business with the whole world by word of mouth. But in many large business establishments and factories there is, in addition, the house telephone system, quite independent of the other in ownership and operation, and even in its manner of doing its work. This system is really nothing but an extension of the speaking-tube idea, which may borrow the electrical features of the public utility telephone for the sake of the greater range thus obtained, but which is after all nothing but a glorified speaking-tube system.



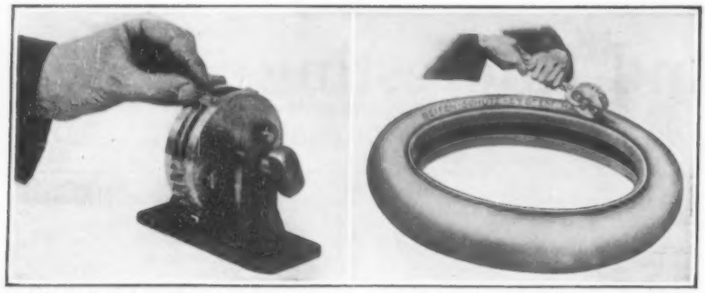
Bringing carbon and paper together with a minimum of effort

The same inconvenience that plagues the telephone company, and that constitutes a very large part of the company's cost of operation, is also felt in the plant telephone system. Just as the removal of a subscriber entails revision of wires, switchboards and directories, so every shift of a foreman's desk, every interchange of headquarters between two departments, every change in the physical layout of the plant that may be called for by increasing or decreasing business, carries in its train the necessity for shifting wires and instruments. In the case of the plant telephone system, in fact, this inconvenience and expense is even greater than in the case of the commercial telephone company; for in the latter case a highly trained staff exists for the sole purpose of doing this work, and in the former no such advantage is present.

With all this in mind, a German inventor has developed a wireless system for the house telephone. In place of the dial selection of the number representing the extension which it is desired to call, the sending side of the instrument from which the call is made has means for adjusting the outgoing wave-length in steps of 20 meters. The receiving side of each instrument, on the other hand, is fixed and incapable of adjustment. The "directory" of the intramural lines indicates the frequency to which each instrument responds, and one makes the proper adjustment of one's transmitter to get the desired party. As far as the acts of speaking and listening are con-



The interdepartmental radio

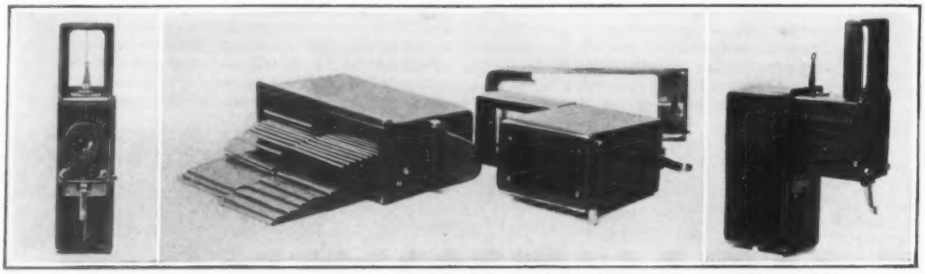


A branding iron for circumventing the tire thief. Any desired inscription may be set up and impressed upon the tire

cerned, the instrument has receiver and mouthpiece quite like the conventional wired phone, as our photograph on the preceding page makes plain.

The Photo Revolver

THE device is grasped by the hand and pointed at the object, quite like a revolver. Nothing is wanting to complete the idea, for there is a sight at the top in the shape of a finder which is to be looked through when directed to the object, and a trigger at the bottom for letting off the shutter. This little camera is a patented production of French make, and has recently made its appearance at Paris. Although the plates which it uses are of a small size, the optical part with the Krauss-Zeiss lens is near perfection as regards a sharp image, so that the plate can be enlarged about 15 times. No less than 48 plates are carried in the magazine, each in its flat metal holder, and the plates are readily changed over. One of the features of the optical part is the patented method of securing an exactly sharp image on the plate in all cases, this no longer being made to depend on the position of the metal plate holder (which might get out of shape) or upon any of the mechanical parts; but the lens is in principle carried directly upon four corner-posts which are pressed by springs against the plate itself, so that nothing can be more exact in the way of a sharp focus. An extra-brilliant image is the result, and this is imperative, for in cameras of this class all depends upon a perfect negative to begin with, if a good enlargement is to be obtained. The present camera may be said to represent the very latest in the way of magazine cameras of this class, and a good point is that it can be operated altogether by one hand. The finder is of good size, and is folded down over the lens so as to form a protecting cover.



Three views of the tiny French camera that looks and that "shoots" like a revolver. Note the magazine with space for 48 plates

Stamping Tires to Prevent Theft

IN the severe economic crisis at present prevailing in Germany, raw materials and goods of every description have, of course, assumed unprecedented value and unlawful attempts to become the owner of such objects are therefore the order of the day.

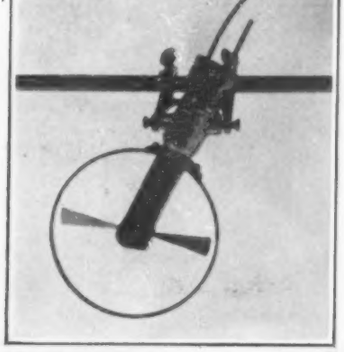
Under these conditions, it becomes imperative that the theft of such valuable material should be either prevented or made useless by a proper mark inseparably clinging to the object in question. This has been done by H. Hansel, of Giessen, in the case of motor-car tires, by designing special stamping machines melting into the rubber an indelible mark, without, however, in any way injuring the rubber or reducing the life of the tire. The stamping is permanent, any attempt to erase or remove the mark by grinding, cutting or vulcanizing being detected immediately. The stamp is produced at a place subject to no wear and tear, throughout the circumference of the tire.

The types desired having been inserted in the type wheel, the latter is heated to a temperature of 220 to 300 degrees Centigrade, seized between the center points of a pair of tongs and, under proper pressure, rolled slowly by hand over the surface to be stamped.

The same thing is, in the case of machine belts, achieved by a similar outfit, which prevents any too-deep stamping mark. No heating is, of course, required in this case.

A Novel Windshield Protector

THIS is a device to prevent rain, snow, sleet or fog from collecting on windshields of automobiles. It consists of a two-blade fan placed in front of the windshield and driver. As the blades revolve an outward pressure of air is created of sufficient force to drive the rain or snow away, thus enabling a clear vision through the glass. The protector is adjusted on an iron rod to suit the convenience of the chauffeur. Power to propel the protector is obtained by means of a flexible shaft extending from a pulley attached to the fan shaft of the automobile. The size of the pulley used determines the number of revolutions per minute, about 700 being necessary to keep the windshield clear. The appliance is adaptable to street car and locomotive windows.



This fan keeps rain and snow off the windshield, but does not itself interrupt vision

The Labelled Gear Shift

SOME few years ago the automobile manufacturers, in more or less formal convention assembled, agreed that the industry would be benefited if all cars shifted gears in the same way. Up to that time, each manufacturer had put his four speeds more or less at random on the four corners of his H; and, of the 24 possible combinations on a three-speed-forward-and-one-reverse car, practically all were in use somewhere.

The standard agreed upon was the familiar arrangement, with the first speed nearest the driver (of a left-hand-drive car), and the third, second and reverse around the circle in that order. From that date, theoretically, anybody could drive anybody's else car, without learning the position of the speeds and without danger of backing into the following car when he thought he was going into second. But practically, the unpleasant fact is that two of the largest producers of three-speed cars have clung to their own distinctive arrangement of the speeds; that several less prominent cars have failed to adopt the standard scheme; and that, in a car with four speeds forward, there is not even any recognized convention to regulate the position of these in the more complicated slot that such a design calls for. The result is that in many cases drivers using strange cars are puzzled by the unfamiliar gear shift.

The maker of a German four-speed-and-reverse car now comes forward with a clever means of relief. On the knob at the top of his gear shift lever, he has cut a diagram of his gear-shifting slots. Each position he has marked plainly 1, 2, 3, 4, or R, as the case may be. The result is that anybody who knows enough to depress the clutch while shifting the gear lever can make—not, perhaps, a noiseless, but surely a successful shift of gears in this car. American manufacturers would do well to copy—especially American manufacturers situated in Detroit and Flint who put out every year a large number of cars with unstandard shifts. Even with the standard shift, the marking would be a great help to the beginner, and no annoyance whatever to the skilled driver.

Making certain the selection of the right gear

Serving Condensed Milk Made Easy

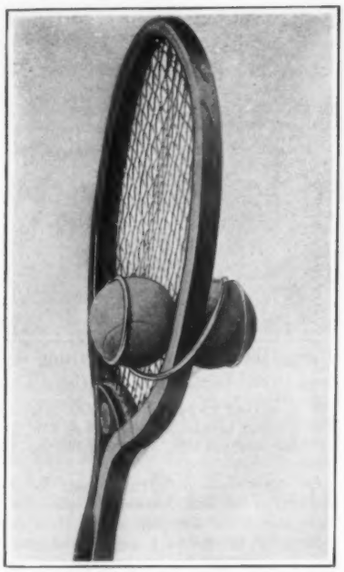
A PRIZE of $500 was won not long ago by a lad of 14 years who was fertile-minded enough to design an attractive and practical serving dish for condensed milk. The youthful inventor's name is Aymer Williams.

Condensed milk, because of its consistency, is not altogether an easy thing to handle at the table even when it has been poured from the can into a cream pitcher. And when once decanted from the can the ordinary container does not protect it from the air. Hence the Art Alliance of America offered a prize of $500 for the most acceptable design for a container which would not only facilitate the serving and keeping of condensed milk when made ready for the table but which would be decorative as well.

As is generally known, condensed milk will not pour freely and it is not easy to dip out with a spoon and to avoid dripping. Young Williams had, therefore, to devise means whereby the peculiar characteristics of condensed milk could be dealt with easily; and in the competition his design was one of 1500 submitted, but the only one that satisfied all of the requirements. His "servalait," as it is called, is a covered bowl equipped with a deep, broad spoon and a scraper, both of which can be kept within the bowl when the cover is on.

By passing the scraper through the filled spoon, the condensed milk is readily dropped, in the desired quantity, into either the tea or coffee cup, and this can be accomplished without the milk's dripping over the edge of the bowl. When not in use, the scraper and spoon are held in such positions within the bowl that they rest above the level of the fluid. With the cover on, the servalait is dust proof and looks not unlike a conventional sugar bowl.

The dripless condensed-milk server



Twisted wire that keeps the balls always where the racket is

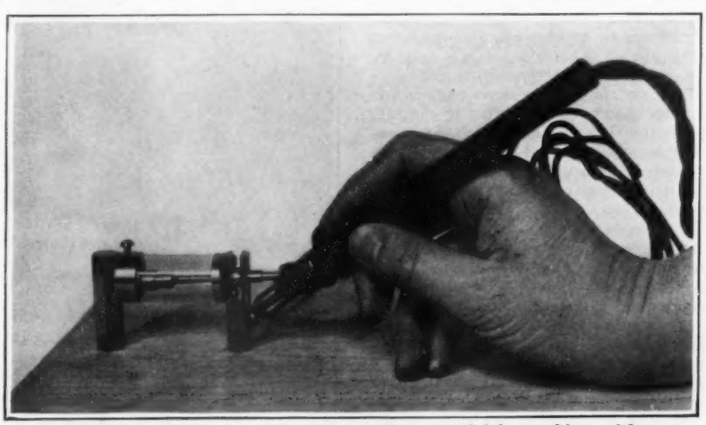
An Anchor for the Tennis Ball

A SPIRAL wire spring is designed to hold tennis balls securely to the racket for safe keeping in the home or for carrying to and from the tennis courts. The majority of tennis players do not use a racket cover or case as the cover is often a source of trouble at the court. Many cases in any event are made without a receptacle for the holding of the tennis balls, the player, therefore, being forced to carry the tennis balls in hands or in pockets, and to store them in bureau drawers or other odd corners about the house.

The spiral wire is of polished brass with just enough tension to hold the balls to the racket securely at all times. A small loop on each end of the wire holds a ball to each side of the racket. The wire is light, easily handled and more quickly and easily disposed of while the game is in progress than the average tennis-racket cover. The wire holder may easily be used with a racket case, in any event.

Tiny Soldering-Iron for Radio Work

RADIO soldering requires the use of an extremely small iron—one that must be specially made, and that is not always easily obtained. The soldering-iron shown is about the size of a fountain pen, and utilizes electrical energy for heating its point. A soft wire solder is used in connection with the iron, one that does not require a very high temperature.



Electric soldering iron of miniature lines, useful in working with radio apparatus

The Wrench That Cannot Slip

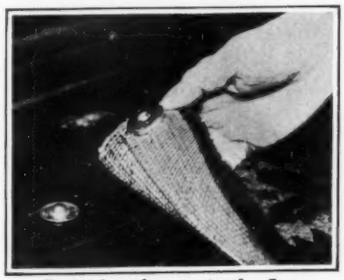
INVENTORS without end give official recognition to the fact that the conventional, old-style "parallel-jaw pliers" constitutes a pretty unsatisfactory tool. Among the better styles, high rank goes to the one illustrated herewith. It really looks as though this tool gets away from all the inconveniences which have inhered in the use of pliers as a wrench. It will be observed that there are no screws or pinions to wear out. The tool will do anything that a monkey wrench will do, and a lot of other things. The lower jaw, which does the heavy work of engagement and disengagement, is renewable. And, of course, there is the hammer head on the back of the jaw for light work, and the screw-driver at the end of one arm. Now on the market in three sizes, five more will shortly be added.

Disguising the Joints in Concrete Roads

UNSIGHTLY black lines, sometimes jagged and irregular, which mar the appearance of practically all concrete roads and which are due to the natural color of materials used to fill joints and cracks, will be avoided by the use of a material for the purpose developed in the laboratories of the Bureau of Public Roads, United States Department of Agriculture, if tests by actual use prove as successful as expected. This material has the same color as concrete, and when used to fill cracks and joints the surface has the appearance of a continuous and unbroken slab to the casual observer.

No particular advantage over other good materials is claimed for the preparation other than its color, and it is probable that the cost will be somewhat higher but not prohibitive.

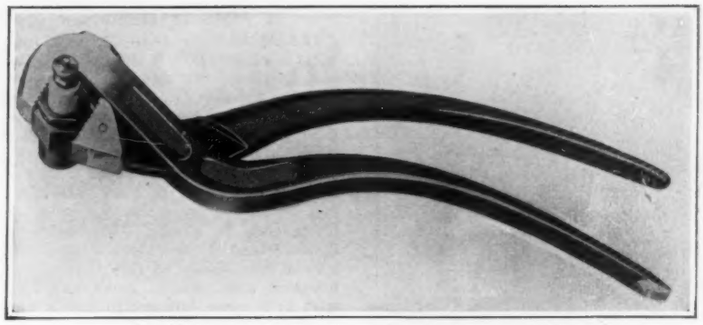
For several weeks a section of road



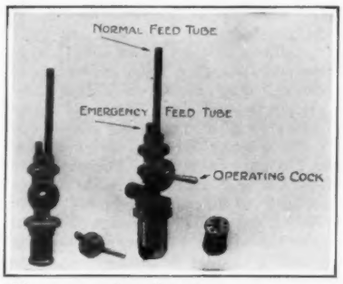
Buttoning the rug to the floor

with expansion joints filled with this material has been under observation, and the results are entirely satisfactory, but a longer test will be necessary before it can be recommended for general use.

The mixture consists of approximately twelve parts rosin, one part crude rubber, with sufficient barium sulfate to give the desired color. In preparation the rubber is dissolved in gasoline, and the rosin is then mixed in with an application of heat, the coloring material being added as required. Any desired consistency can be obtained by varying the proportions. A material with remarkable adhesive properties is produced and which can be heated so that it will flow into the cracks and joints.



Parallel-jaw ratchet-action wrench of a new style



The connection that insures a couple of gallons of gas after the supply has apparently failed

The Non-Skid Rug

RUGS that skate about the floor when one steps on them hold a place, as cause of household accidents, second only to that of the bare polished floor. But now we have a device for buttoning them to the floor so that they cannot skid. It is nothing other than the snap garment fastener adapted to this new purpose. Four fasteners are used on each rug, and the heedless caller may hit the rug as hard as he pleases without bringing down disaster upon his head—or upon his feet.

A Hot-Air Ventilating Fan

SOMETHING new in ventilation for the coming summer is illustrated herewith. The fan is not electrically connected, but is driven wholly by the hot air rising from the alcohol burner that stands beneath it. The inventor states that the dissipation of this hot air by the fan is not nearly sufficient to overcome the ventilating and cooling effect, if the fan is but given a supply of cool air to drive.

Gas for the Forgetful Motorist

EVERY motorist has had the sad experience of forgetting to replenish the gas-tank, and of being marooned—usually miles from nowhere on a stormy night—without any of the precious go-juice to get home with. We have one acquaintance who boasts of his predilection toward this sort of thing. His car carries an auxiliary two-gallon container, but this is of no avail. After it is filled, the owner travels until he is halted by "no gas"; then he empties the auxiliary supply into the main tank, travels to the nearest gas station, and fills up again. But he invariably forgets to fill the auxiliary tank; so every alternate failure of his car to run without gas leaves him stranded and an object for the good samaritan.

One of the leading British manufacturers has installed a very clever little device that is somewhat different from the conventional auxiliary tanks, false bottoms, etc. The gasoline feed-tube projects some distance up from the bottom of the tank, so that the fluid fails to enter it while there still remains a couple of gallons at the bottom. When the car comes to an unexpected halt, the driver has but to turn the operating cock, and a second intake valve, at the level of the tank's bottom, comes into play, so that all the gas in the tank is now available, while the driver has had warning to fill up. Of course, if he fills up and forgets to set the cock back to its original position, he is inviting future disaster; but that is another story and not chargeable to the device.

Our illustration shows the upstanding tube with the operating cock that is accessible from beneath the tank, together with mounted and dismounted views of the clever filter that forms part of the outfit.

Electric Starting Systems for the Motor Truck

STARTERS utilizing electric motors to turn over the truck engine are now considered the ideal starting device. The capacity of a modern system is very high as the motor may draw current from a storage battery and keep the engine turning over for half an hour on a charge. The objection formerly advanced against their use, that it requires considerable complicated and costly apparatus which is difficult to understand and which requires the services of an expert electrician to repair should it get out of order is no longer true, because the development has greatly simplified the units and the various systems are now well understood by all. Electric starting and lighting systems have been made in many forms; though the basic principles of operation are practically

Something new in ventilating fans

A 48-inch hand-saw made for a special purpose

the same in all systems, they can be grouped in several main classifications. It will not be possible to describe all in a short article of this nature, but if the features of the leading systems are outlined it will not be difficult for the truck driver or repairman to become familiar with the principles of other systems which may be different only in points of minor detail. Not only do the individual systems vary in detail, but the components of the same system are often of different construction when used on trucks of different makes.

The standard equipment must include three main parts: the battery, the generator, which is driven by the engine and which produces electric current to keep the storage battery charged, and the starting motor, which is in mechanical connection with the engine and in electrical connection with the storage battery when it is desired to turn the engine over for starting. If the motor and generator are combined in one instrument, the starting system is known as the "one-unit" type. If the motor is one appliance and the generator another, the system is said to be a "two-unit" type. Each of these has advantages, and both forms have demonstrated that they are thoroughly practical. In addition to the three main items enumerated, various accessories, such as switches, ammeters, connectors, wiring, protective current breakers, automatic current regulators, etc., are necessary for the convenient distribution and control of the electric current. Starting and lighting systems are particularly applicable to the modern "speed wagon," or any truck equipped with pneumatic tires. As a rule, solid-tired trucks are not suitable for electric systems because of rapid battery depreciation. On solid-tired trucks, special spring suspensions for battery-box support are desirable.

The ironing connection with the switch in the handiest place

A Monster Hand-Saw

CLAIM is made that the saw illustrated herewith is the longest hand-saw in the world, and it surely seems that the burden of proof might be placed upon the shoulders of anyone contradicting the statement. As the picture shows, the saw was made for a special purpose—to cut rolls of paper wound on brass tubes. Many of these rolls are a full 24 inches in diameter, while the brass core is usually two inches in diameter and of one-sixteenth inch stock. The mighty sweep of this 48-inch saw, however, goes through paper and brass with little more difficulty than if it were an ordinary job of wood-sawing.

The Decarburization of Ferro-Chromium by Hydrogen

THERE has been developed recently in England a "rustless iron." This material is iron to which a certain proportion of chromium has been added. A similar alloy called "stainless steel" has for some time been familiar to metallurgists. Stainless steel differs from rustless iron chiefly in that it contains small amounts of carbon, making it actually steel rather than iron. In order to produce rustless iron, and iron-chromium alloy free from carbon, it is necessary that carbon-free iron and chromium be available. The usual forms of chromium, commercial grades of ferro-chromium, contain comparatively large amounts of carbon. The discovery of rustless iron has thus made it very important to be able to treat ferro-chromium by some process which will remove the carbon. Among the methods proposed is that of heating ferro-chromium in contact with hydrogen.

Through experiments conducted by the Bureau of Standards it has been found that ferro-chromium heated in hydrogen loses carbon slowly at temperatures below the melting point of the alloy. When hydrogen is bubbled through molten ferro-chromium, the loss in carbon is very rapid. It may be possible to prepare low-carbon ferro-chromium by blowing hydrogen gas through molten ferro-chromium in a converter of the type used in the manufacture of Bessemer steel.

This work is described in Scientific Paper No. 448, available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

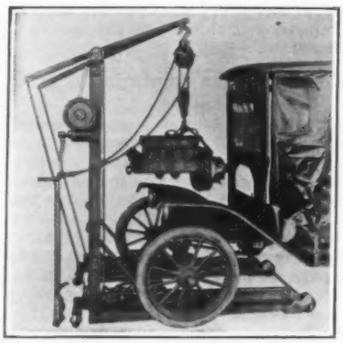
The latest device for making it easy to get under a crippled car

A Time Saver for the Ironer

IN the operation of ironing one reaches up to the connecting switch, or disconnects the iron plug, a great many times. This connecting switch has a push button in the plug. Current can be cut in a second's time. Cutting of current saves the electric bill, also the heating element in the iron, which is not of indefinitely long life, at best.

The Band-Saw in the Butcher Shop

EVERYBODY knows how the mechanical meat-chopper long ago superseded the old time rat-a-tat-tat of cleavers on bench; and how, later, elbow-grease was replaced by the electric current in suppying motive power. Now comes another chapter in the motorization of the butcher shop; and this time it is the ordinary steak and chop and roast that get cut by electricity. A light band-saw is rigged up, and bites through the carcass quite as easily as the delicatessen man has already demonstrated that it will bite through the portions of the pig's anatomy that come to us as ham and bacon.



A one-man engine hoist for automobile work

A Hypersensitive Barometer of Small Size

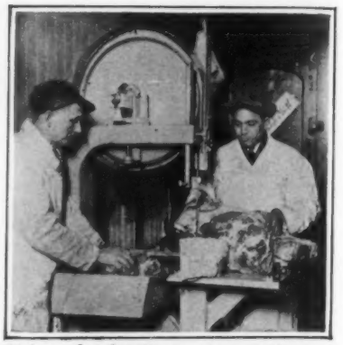
A BAROMETER small enough to carry in one's pocket and yet sensitive enough to indicate a change of four inches in altitude has been invented by Mr. G. Paulin, a Stockholm engineer. The instrument is an aneroid barometer constructed on a new principle not yet revealed to the public. The tests have been going on for some time at the Swedish Hydrographic Institute and have been so successful that a large number of instruments has been purchased by the government. Various types of the Paulin barometer are devised for navigation, aviation, engineering, military purposes, tourists, etc. An apparatus on the same principle has also been perfected by Mr. Paulin for medical use in taking blood pressures.

Greater Garage Efficiency

MORE and more the fact is being recognized that it takes a garage mechanic time to crawl around and under and through a car on which he is working; and that while this time is charged up to the customer, greater profits lie in increasing the amount of useful work that the repair artist can do in a given time.

Thus, with a new hoist and crane, an engine can be overhauled without being taken out of the frame of the automobile, the main and connecting rods can be adjusted and other work underneath the automobile performed. It permits the workman to get at the job in a comfortable position and the job can be properly lighted up and is easy of operation requiring only one man for its entire manipulation.

The rear axle work can be performed or the front wheels raised to adjust the steering gear. The hoist is tested at 13,000 pounds and will therefore take any make or weight motor car. It is provided with a safety locking device so an automobile may be locked at any desired height, and is equipped with a crane attachment by which an engine or any part can be taken from a car and carried to any part of the shop, as the hoist and crane is portable. The crane has a lifting capacity of 3000 pounds. The lifting height of the hoist for the average automobile is from 48 to 53 inches.



Using the band-saw for cutting up meat

Of somewhat different intent is the apparatus of our second picture. We have shown in the past more than one device for up-ending a car and allowing the repair man to work at its underbody without doing the snake act; and with garage pits being legislated against on the ground of fire hazard and asphyxiation possibilities, such apparatus will doubtless come into more general use. The one which we show possesses an unusual degree of portability. Either end of the car stands on its own wheels while the other end is thrown up at any angle dictated by the workman's convenience. The free end is blocked to prevent the car's sliding off its cradle, and measures are taken to prevent the latter, too, slipping. But if anything did slip, the worker would not be hurt, since the stout framework would shield him and prevent the car from falling on him or from capsizing the frame upon him.

A New Adjustable Rim-Bolt Wrench

THIS universal rim-bolt wrench is instantly transformed from one wrench into four accessible sockets, a socket for any standard rim bolt made. The sockets are all included in one wrench. A slight pressure under the socket releases the locking device, permitting the turning of the spider to the required socket. The spider is automatically locked, the harder the resistance the harder it holds. With its 18-inch length and easy rolling hand grip, it gives ample leverage for an ordinary rim bolt job. In stubborn cases the leverage can be increased 300 per cent by turning the wrench handle to a right angle to the socket. The wrench is made of drop-forged steel with a rust-proof copper finish.

One wrench for all the rim bolts in the world

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

New Iron Ore Discovered in Germany

AT a recent meeting of the German Geological Society it was reported that a new iron ore had been found in the North of Germany. The ore is called "white iron ore" and consists almost entirely of pure iron carbonate. The ore is found in bands of two meters in thickness in the low-lying moorlands of North Germany and is said to be worth exploiting.—*Jour. Soc. Chem. Ind.*, 1922, page 421R.

Nitrous Oxide Important Food Preservative

IN the German journal, *Archiv. Hygiene*, 1922, volume 91, page 1, there is given an interesting account of a number of experiments, made with nitral, nitrous oxide, for the preservation of food. Fresh whole milk may be conserved at a nitral pressure of 30 to 35 atmospheres and a temperature of 37 degrees Centigrade in such a degree that the milk will maintain its fresh condition for as long as a month without being cooled or watched in any way. The milk is kept in its original condition and its nutritious value is maintained constant. In a similar manner such foodstuffs as meats and fish are preserved effectively by the use of nitral. Preserved meat and fish will keep fresh for a far longer time than ordinary fresh food. The cooking of such food may be carried out without any difficulty and the taste of the cooked product is satisfactory.

Stearin and Glycerine from Soya Bean Oil

A NEW Japanese process has been introduced in Japan for the production of stearin and glycerine from a soya bean oil.

Dutch Clinker

IN many Dutch and German streets, especially in the former, a beautiful bluish clinker is used for street paving. Little is known of the nature and origin of this material, but usually it is the so-called Dutch clinker which, by the use of suitable raw materials and fuel, is obtained after long baking in the form of very durable bricks. The baking is carried out in the simple clamp-kilns, though ring kilns with a temporary reducing atmosphere have been successfully introduced in the North of Holland. The best fuel is a cut peat of medium calorific value and the firing period lasts from 15 to 20 days, according to the size of the kiln.—*Jour. Soc. Chem. Ind.*, 1922, page 421 R.

Phosphate Fertilizer Without Aid of Sulfuric Acid

ACCORDING to the *Zeitschrift fuer angewandte Chemie*, Oct. 3, 1922, "Rheania" phosphate solves the problem of making a high-grade fertilizer from low-grade phosphate, without the use of sulfuric acid. The process consists of heating to 1200 to 1300 degrees Centigrade an intimate mixture of crude phosphate, limestone, and alkalin silicate, such as feldspar, phonolith or leucite. The product is a brown mass which is pulverized before marketing. The fertilizer can be used on any type of soil, and, inasmuch as it is strongly basic, the use of lime is not required. It possesses the great advantage over superphosphate in that it does not need sulfuric acid in its manufacture. Furthermore the poorest grades of phosphate rock can be used for making this product. Certain factories in Germany are making the product and it is claimed that nearly one million tons of the fertilizer have been sold. The evidence of pot experiments and field trials is favorable.

Designs Formed with the Aid of Iron Powder

THE use of powdered iron in lacquers is for the purpose of securing designs or geometric figures on the lacquered surface of the article. This may be done by suspending bronze powder in a five per cent solution of cellulose acetate and adding thereto iron powder which has previously been passed through a fine-mesh screen. A thorough mixture of these materials is made and then the lacquer may be poured on a smooth surface and subjected to the action of a magnet. The magnet attracts the particles of iron and causes them to assume geometrical forms, which are retained after the lacquer has set. For further details the reader is referred to German Patent No. 235,381.

Improved Candies With Soft Cream Centers

ACCORDING to the *Journal of Industrial and Engineering Chemistry*, the Bureau of Chemistry has developed a cheap, effective and rapid process for preparing chocolate creams having very soft cream centers. The semi-liquefaction of the centers has been secured by the action of invertase in the place of acid. The process will be patented and dedicated to public use.

Cactus As a Fodder

THE cactus is first exposed to a torch which burns away the thorns, and is then carried to the slicing machine, of the type that is used in sugar works. The machine is provided with specially formed knives and the cactus is cut up into slices, which are then dried and if desired ground into the form of a fine powder. During the slicing operation part of the juice, which is exuded from the cactus, may be pressed out and collected separately. This juice can then be converted into a substitute for gum arabic, which is probably a salt of meta-arabic acid. The yield of dry material, the fodder, is about 11 per cent of the weight of the raw cactus.—*Journal of Engineering and Industrial Chemistry.*

Cleaning of Aluminum Utensils

IN the cleaning of aluminum pots the housewife must always be careful to use no caustic materials. But, as grease and fat are best removed by simple boiling with a hot soda solution, this fact has been a great hindrance in the use of aluminum ware. It has been found that the addition of a small amount of sodium silicate (water-glass) will prevent the caustic substances from exerting their solvent action on the aluminum metal. In the case of a five per cent soda solution it is only necessary to add one hundredth part of the weight of soda in sodium silicate to secure perfect immunity from attack by the soda. There are various products on the market today, recommended for cleaning aluminum ware, which are merely mixtures of soda and water-glass.—See *The Chemical News*, Sept. 29, 1922.

By-Products From Peanut Oil

A VERY interesting report of the peanut oil industry and the by-products produced therein is given in the Bureau of Chemistry Bulletin No. 1096. The peanuts are treated in the same type of apparatus that is used in the manufacture of cotton-seed oil. The by-products are peanut oil cake, which is the product that is recovered after the oil has been pressed out or extracted with solvents; peanut oil meal, which is obtained by grinding the peanut oil cake; and unhulled peanut oil feed, which is obtained by grinding the residue, that is left after the extraction of part of the oil from the whole peanut.

New Heat Insulating Materials

IN building cold-storage plants or refrigerators, it is necessary to fill the double walls of the structure with material that possesses heat insulating properties, so that the warm air cannot penetrate into the inside of the refrigerators. Many materials have been used for this purpose up to the present time, such as ground cork, asbestos, etc. In the *Chemical Trade Journal* of Oct. 27, 1922, there is given a description of a few new materials that have been recommended for this purpose. The first is expanded rubber, that is, rubber that has been subjected to the action of gas, developed within the rubber composition during the process of vulcanization, which results in the rubber swelling up considerably and forming a porous mass. Such rubber will weigh only about five to seven pounds to the cubic foot. Basswood, which is the lightest wood known, is also used for this purpose. This wood comes from the tropical regions of Ecuador and weighs 5.7 to 8.6 pounds per cubic foot. It is made water-proof by treatment with preservatives and is said to make a good insulation. The fibers of the plant, known as Kingia Australis, which grows in the poor soil along the coastal belt in Western Australia, also forms a good insulator for cold-storage work. The tree grows 20 feet high and one foot in diameter. Another good heat insulator is made from eel grass. The cured eel grass is sewn in between strong paper to form what are known as eel grass mats. This grass grows in salt water and contains largely silicon. It does not harbor insects and vermin.

Locating Minerals by Radio-Activity

THE venerable French scientist, Abbe Estines, recently reported that he had discovered a method of locating oil and mineral deposits. This method is claimed to be absolutely accurate and scientific. While the most exact nature of the method is not disclosed, it is said that it is based on radio-activity. The instruments used weigh 300 pounds and work best, it is claimed, between 2 and 5 o'clock in the morning, when the earth is at its coldest. The Abbe says that his method has enabled him to discover that there are petroleum deposits in numerous parts of Europe. If that is so, then a very great service has been performed, for the French have been trying for the past few years to locate oil in their own country, so as to be free from the necessity of buying oil and oil products abroad. Further details regarding the invention are expected to be published shortly.

Straight Silica Glass

A DEPOSIT of silica mineral of volcanic origin has been found in Czechoslovakia, which can be used directly in the manufacture of glass without the need of adding any of the other common ingredients used in making up the glass batch. This silica mineral is said to resemble lava and it is understood that the deposits are very large and that steps are being taken to utilize them commercially.—*Chemical Trade Journal*, Oct. 15, 1922.

Ferry Metal, a New Bearing Metal

FERRY METAL is a bearing metal, which contains lead in the place of the dear tin, and which in general is made up of 96.75 per cent lead, 2 per cent barium and 1 per cent calcium, is not attacked by oxygen. The alloy melts at a temperature of 445 degrees Centigrade and after it cools off, it gradually becomes harder, the older it gets, Its hardness by the ball pressure test is 22.6 directly after cooling; after seven days it has increased to 24.4 and after 28 days it becomes 25.7. The strength of the alloy is about the same as that of duraluminum. The fact that there is but a slight decrease in the hardness of the alloy up to a temperature of 150 degrees Centigrade is of important technical significance in the use of the alloy for bearings.—*Chemiker Zeitung*, 1922, page 951.

Motor Fuel From Maize

ACCORDING to the *S. Afr. J. Ind.*, August, 1922, a company has been organized to manufacture industrial alcohol from maize. There is a large field for industrial alcohol in South Africa and particular attention has been paid to the development of a motor fuel with alcohol as a base. The factory will be in operation inside of a year.

The Ruth Heat Accumulator

IN the December 21, 1922, issue of *Paper Trade Journal* there appeared an article on the Ruth heat accumulator, which is the first article on the subject to appear in American journals. The heat accumulator is a very important piece of apparatus, invented by a Swedish engineer, Dr. Ruth, and finds an important place in any plant where the demands of steam are irregular and intermittent. The apparatus acts as a store-house of steam, generated in excess while the demand is low and given up when the demand is great, greater than the capacity of the boilers. It is merely a cylindrical vessel, with rounded ends, containing a constant quantity of water. The dimensions of the apparatus and of the various distributing pipes and valves, the amount of water in the apparatus and other conditions are regulated exactly so that there is only a slight reduction in pressure of the steam leaving the accumulator with respect to that of the steam entering the apparatus. The heat accumulator works at a high efficiency and affords a very satisfactory means of regulating the operation of the boiler plant.

Where the Compass Fails to Guide

By N. H. Heck

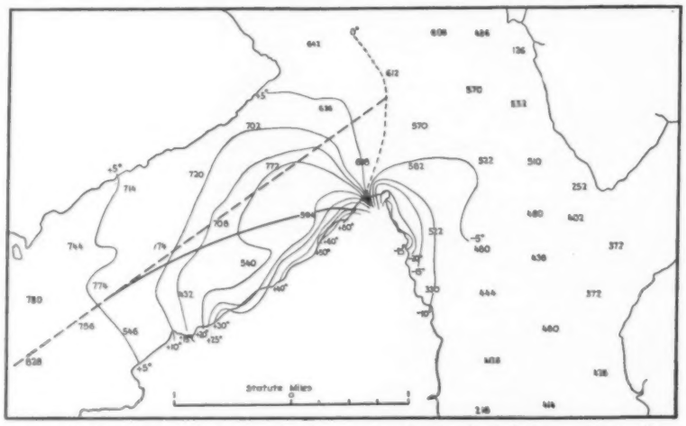
Hydrographic and Geodetic Engineer, United States Coast and Geodetic Survey; Chief of Division of Terrestrial Magnetism

TRUE as the needle to the pole, has been the watchword of the mariner for centuries. Even with the knowledge that the direction of the magnetic needle is constantly changing, the changes are so small and so slow that the mariner never has to question the magnetic courses obtained from his chart, provided that the chart is up to date. The chart of course shows the general value for the region, as obtained from magnetic surveys.

There are, however, a number of places on the earth's surface where the compass is not a guide but a source of danger if trusted too far. One of the most interesting of these has recently been carefully surveyed by the steamer "Explorer" of the United States Coast and Geodetic Survey, at Port Snettisham, an inlet of Stephens Passage, Southeast Alaska, not far from Juneau.

In this inlet the shores are generally bold and rocky and the land rises to heights of 4000 feet at some distance back from the water's edge. The land is heavily wooded and it was fortunate for the purposes of the magnetic survey that so much of the area could be reached by water.

In the diagram the curved lines marked at the ends mean, for example, that on every point on the line marked 10 degrees the compass points 10 degrees east of general magnetic north for the region. If a minus sign appears before the number the compass points that much west of the magnetic north. For the area between any two lines the value is between those given for the lines. It should be noted that these lines all converge toward a point on the land. There is every reason to believe that there is a true local pole which has the same characteristics as the magnetic poles of the earth: that is, a compass needle will remain in any position in which it happens to be left, while a needle mounted to swing on a horizontal axis will point directly downward.



A vessel attempting to sail, by compass, the course marked by the dash line would actually follow the solid line and go ashore, as indicated, near the local magnetic pole that causes the disturbance. For full explanation of the diagram, see text

Magnetic survey of an Alaskan inlet where the compass goes badly astray

The figures shown on the water area are depths in feet. One of the most surprising features is the very large deflection of the compass over great depths. By following the line marked 20 degrees it will be seen that it passes over a depth of 772 feet nearly a mile from the shore. Even though in this case there is land nearby, the rather startling possibility of marked deflections of the compass in offshore areas of considerable depth is indicated.

A land surveyor trying to use the surveyor's compass in this region would be reduced to helplessness, and this brings out strongly an important defect in the method by which so many land surveys have been made, as local magnetic disturbances of small amount exist in many places throughout the United States. It is one of the functions of the Coast and Geodetic Survey to map such areas and keep the surveyor informed.

The most important feature of the Port Snettisham region, however, is brought out by the heavy, full and dotted lines. The dotted line is the path that would be followed by a vessel to keep in mid channel and nowhere in less than 600 feet of water. In a region of no magnetic disturbance the course which would keep a vessel on this line could be readily obtained from the chart. The full line is the course actually taken by the vessel if she follows this same course, *by compass*. She would ground near the place where the disturbance is greatest.

Fortunately this is not one of the main channels. It is, however, the entrance to the only pulp mill in Southeast Alaska, and the vessels carrying the materials for the construction of this mill and its products have passed through this inlet. This has been in the daytime and the compass was disregarded. These are the same passenger-carrying vessels that traverse the main channel. The illustration shows what would have happened if the passage had been attempted during a thick fog with the usual reliance on the compass.

The "Explorer" in making the survey could not use the compass for guidance in this work as is customary. She was steered for some object on the land ahead and the actual direction of the compass was obtained at short intervals. When passing along the shore near the point of greatest disturbance the compass kept steadily swinging toward this point. As the point was passed it suddenly spun through 55 degrees in the opposite direction, then gradually came back to normal as the area of disturbance was left behind.

The natural question is what causes this great disturbance of the compass, which is felt over an area of twenty square miles of land and water and is strong over an area of eight square miles. There is a gold mine in the vicinity and it is safe to say that it is caused by associated minerals. Whether there is a large mass of the useful iron ore magnetite, and whether, if so, it is workable, is a matter for the future. It is certain that there is an immense mass of magnetic material.

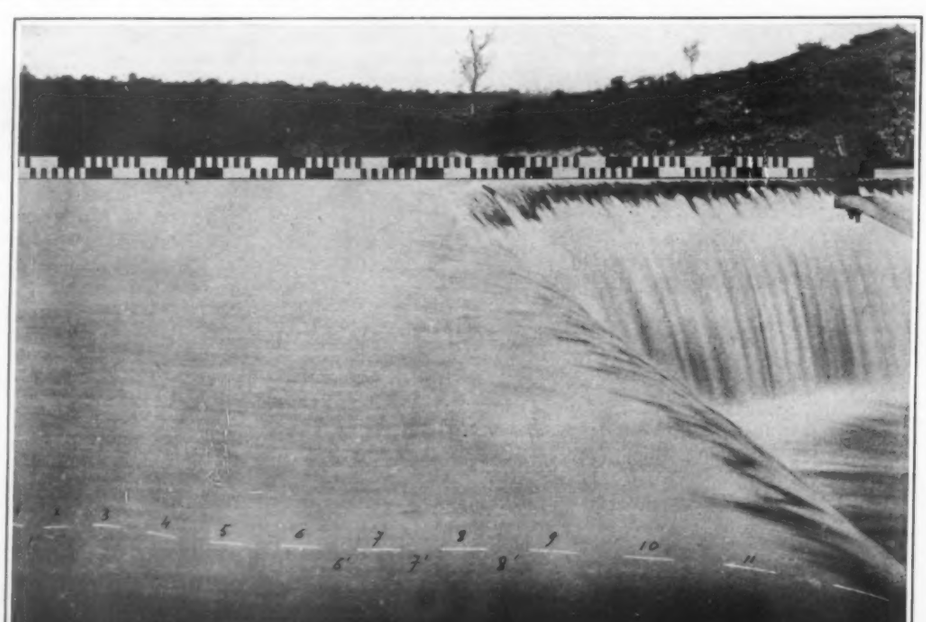
Measuring Water Flow With a Camera

FACILITY in use is the key-note of the new method of measuring rate of water-flow devised in France by Professor Morin. The principle involved is one of timed photography already put in practice by Morin in determining the flight of falling bodies and the movement of projectiles.

We have all seen photographs in which an intense light has moved across the plate and left its trail in the form of a straight line. If now at various points in its path the light passes behind obstructions, its record on the plate will be a broken line rather than a continuous one. The dark intervals will be of lengths depending upon the length of the obstruction and the speed of the light. If we know either of these elements, together with the scale of the photograph, we can calculate the other.

As applied to the measurement of water velocities, the moving light is on a float that is carried along by the current being measured; and the obstruction is carried with it. That is to say, the light reaches the camera through a revolving shutter which is part of the time open and part of the time closed; and whose period is known. The duration of the dark spot on the photograph is therefore known, and on measuring its length we find it a simple matter to calculate the speed with which the float was moving.

Professor Morin has very ingeniously made it unnecessary to wire up his float to a source of current; for instead of an electric light, he uses sunlight, reflected from a powerful mirror into the camera. The image of the sun from this mirror will make an impression upon the photographic plate, even when moving at 20 centimeters per second. Further cleverness is displayed in making this mirror of a small glass globe, two or three inches in diameter, silvered on the inside and ballasted so that it floats half submerged.



Two mirrors, floating down stream, each behind a revolving shutter, reflect the sun's rays to the camera and register their tracks in alternate blocks of light and darkness on the plate. These tracks appear on the developed negative, and afford a means, since the actual duration of each dark interval is known, of calculating the speed of the water at each point. Two mirrors are used, giving two tracks, for checking purposes

Typical photograph on which the rate of water flow is registered

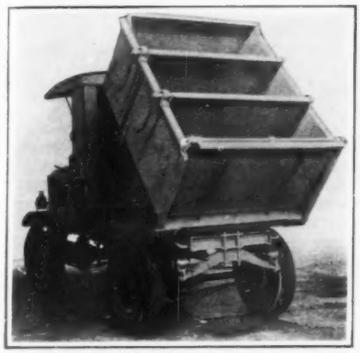
The method has been applied mainly experimentally at the great barrage of Rochebut, on the Cher river. The profile of this overflow is such that from a very slow rate of flow in the reservoir the water comes to have a very rapid flow at the crest of the dam. It will be noted that the rate of flow need not be uniform, since the measurement may be made separately for each of the dark intervals, which need not therefore be of the same length. The silvered globe is attached to a cord and allowed to float to the very edge of the dam, after which it is rescued and used over and over again. Examination of all the details shows that the measurement of the flow is made with no greater error than 1 per cent.

The depth or thickness of the water stream can be measured upon the plate, but it was in the present case directly measured on the spot, and this can be done with the same degree of approximation above stated. When the water is flowing under the above mentioned conditions and over an even and flat surface such as is afforded by the masonry construction, the surface of the stream is not only very regular, but it is found that there is practically no difference between the speeds of flow all through the layer of water and hence all that is required is to ascertain the speed at the surface in order to calculate the actual amount of water passing at any given time, that is, the output of the system in the case of a reservoir or a hydraulic power development.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Four-wheel-drive road-building truck of unusually small turning-radius

New Road-Builder Truck

ONE of the most recent developments by motor truck manufacturers is the road-builder truck which was recently placed on the market by a Wisconsin manufacturer. One of the biggest features of this new truck is its short wheel base of 105 inches which gives it an exceptionally short turning-radius and makes it valuable as a time saver in making turns on the narrow grades without the difficulties often encountered with trucks of the long-wheel-base type. The truck is designed to carry a 3-batch body of three tons capacity, the body to be operated by a horizontal hydraulic hoist and the tail gates to be operated individually. The truck is also designed to be used as a tractor for trailing loads to the concrete mixers and for hauling road machinery. It has a capacity of three tons and the allowance for body weight and hoist is 2400 pounds. The weight of chassis with pressed-on tires is 6175 pounds. The tread is 60 inches, and the short wheel-base gives the small turning-radius of 20 feet, 6 inches.

When fitted with pneumatic tires, the front wheels are provided with 36 inch by 7 inch and the rear wheels with 36 inch by 8 inch. The four-wheel-drive system is used, though only the front wheels are dirigible for steering. The power plant is a standard-make four-cylinder, four-cycle type having a bore of 4¾ inches and a stroke of 5½ inches. The piston displacement is 389.9 cubic inches and the engine is rated at 54 horsepower at 1350 r.p.m. Ignition is by high-tension magneto having an impulse starter. A multiple-disk clutch transmits the power and a transmission having three speeds forward and one reverse of the selective dog-clutch type eliminates all danger of damaging gears in effecting various speed changes. The vehicle illustrated is a very practical construction and is well suited for the work it is expected to perform.

Popular Tractor Equipped With Two New Features

ONE of the tractors long on the market has been equipped with two new features, namely, a front axle extension furrow guide and a new air washer, as shown in the two accompanying pictures. The front axle extension steering device consists of an extension axle which is attached to the fork of the front axle, and which permits of dropping the right front wheel of the tractor in the furrow, and yet maintaining the horizontal position of the tractor, which is so essential in plowing. All other wheels except the right front wheel travel on the unplowed ground when plowing, which is much preferable to running two tractor wheels in the furrow, and besides it permits the use of drive wheel rims wider than the furrow. This new furrow guide which maintains the horizontal position of the tractor is very much superior to many other methods of self-steering as it positively eliminates the possibility of imperfect lubrication, and will prevent undue wear to bearings which are usually caused by side thrust, which is caused when a tractor is not operating in a horizontal position.

The air washer, found on the same machine, will remove all the dust and dirt from the air before it is taken with the fuel into the cylinders, as the air is drawn through water. The screen in the float prevents the air from passing through the water in very large bubbles, and thus clean air is delivered to the carburetor at all times, prolonging the life of the interior motor parts by keeping them free from grit and dust, which is the cause of many a motor trouble.

Severe Tests of Motor Trucks

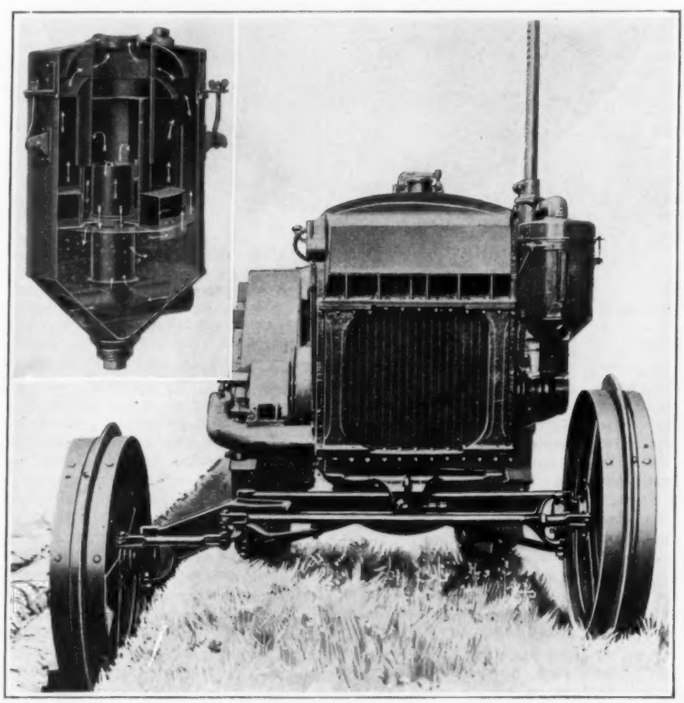
IT does not take long to find the weak spots in a motor truck when it is applied to hauling earth and materials for building and road construction. So exacting are the conditions under which a truck normally operates in this field, that the work may be truthfully called the hardest service a motor truck is called upon to render. A motor truck must have tremendous reserve power and durability if it is to succeed in carrying full loads up excavation inclines over long periods. It must combine adequate safety factors with the highest grades of materials if it is to withstand the racking strain of steam shovel loading. Its rear end must be simple in construction and capable of supporting extreme excess weight if it is to bear successfully the strain of dump hoist unloading.

It must have a flexible frame, combined with proper engine and transmission supports that will not be affected as a whole by the great variation in road surfaces found in all work of this kind. These quality factors are the elements that provide dependability over a long service period, insuring the contractor against delivery tieups with their resultant losses.

The motor truck industry today is turning out a product, the component parts of which embody various standard grades of materials and numerous refining processes. The standard of quality varies with the price paid for materials and workmanship and each manufacturer is thereby enabled to build a product at a price that will meet the demands of a certain market.

Therefore, the relation of quality to price is stable and has become a fixed standard in the motor truck industry. Outwardly, motor trucks may be built to resemble each other closely, but the definite relation of quality to price is ever present. Quality buying is always good business, but it is especially so when applied to the installation of motor truck equipment in the contracting field. In the exacting field of hauling for excavation, road and construction work, the longer a motor truck can remain on the job without developing internal ills, the larger the net profits will be when each month's books are balanced. Ever since motor trucks were first used in such work, experienced operators have looked on the qualities of stability and power as the two essential features which in the end determine the degree of profitable performance.

A summary of the operations of I. Ferger, a Long Island contractor, will emphasize this fact—that motor truck economy is not by any means decided by the number of miles a truck will go on a gallon of gas, but rather on the length of time it will render unbroken service without necessitating mechanical overhauling. Mr. Ferger employs ten 5½-ton trucks. A short period ago five of these trucks were run 24 hours a day for a period of three months while they were engaged in excavation work at the Army Supply Base in Brooklyn. Mr. Ferger says his trucks worked under severest conditions on this job, and that the motors were never really cold from the beginning of this excavation job until the time it was finished, demonstrating the value of high grade construction in a manner that cannot be questioned. A few serious breakdowns due to weak mechanism have greatly reduced the profits on the operation besides delaying the important work.



Details of the axle construction that enables the front wheel to run in the furrow while the tractor goes on a level base; and of the air washer that passes the air through water in small bubbles and thereby insures a good job of cleaning

Attractive features added to a popular tractor

The Gasoline Summer Train

GASOLINE summer trains, whose cars are entirely similar in general arrangement to the familiar open trolley cars, are the very latest in the development of light equipment for railroad service. A two-car unit of this type has just been completed. These cars are of the open type with adjustable curtains along the sides to provide protection for passengers against sun or rain.

The forward car of this unit has a seating capacity of 35 persons and the rear car can accommodate 50. Special care has been taken by the manufacturer in the designing of the bodies of these cars so that each seat provides ample room for five grown persons.

The cars are equipped with air brakes, electric starting device and horn, standard MCB couplers, locomotive type "cow-catcher" on the forward car, sanders for sanding the rails, and high-speed reverse gear which enables the cars to go as fast in reverse as they will go forward.

On short-line railroads and especially on electric lines over which excursions are run in the Summer time, the gasoline railway summer train appears to be the ideal installation for reducing operating costs and at the same time maintaining reliable service.

During the test runs which have been made with this equipment a speed of between 35 and 40 miles per hour has been attained. The cars have rounded curves up to 16 degrees curvature at a speed of 25 miles per hour, without the least trouble and are capable of rounding much sharper curves at a reduced speed. This and other developments made by automotive manufacturers toward the perfection of light railway equipment is evidence of the fact that the automotive industry is awake to the requirements of railroads that are forced to reduce their cost of operation in order to maintain a profitable service.

The Heavens in March, 1923

Topics of Discussion at the Cambridge Meeting of the A.A.A.S.

By Professor Henry Norris Russell, Ph.D.

ANY general scientific meeting—such as happened at Boston just after Christmas—where a dozen technical societies convene at once, along with the American Association for the Advancement of Science, illustrates how intimately the various physical sciences have grown together. Whether the mathematicians were discussing space and time, the physicists the ionization of atoms, or the chemists the structure of matter, all found these fields not merely adjacent, but overlapping; and the astronomer was welcome all along the line, and had hardly time for his own meetings—and even then he heard communications on such topics as "The capacity of an ionized gas" or "Series in the spectrum of strontium," which led again, as all roads seem now to do, back to the atom.

Among these papers of physical interest we may note a few. Nichols and Teal, of the Nela Laboratories, have developed an "oscillator" for the production of Hertzian or radio waves of such small length (one-fifth of a millimeter) that they are actually shorter than the longest heat waves radiated by a mercury-vapor lamp. The gap between the "natural" waves of heat and light and the "artificial" waves used in radiotelegraphy is this completely closed, and it is now possible to produce and study at will waves of any length from many miles to a billionth of an inch.

Physics in Astronomy

Bauer, of the Carnegie Institution, pointed out the very striking similarity between the magnetic fields of the earth and the sun—both being directed in the same general fashion, and not toward the pole of rotation, but a few degrees away from it; both being strongest near the equator; and so on. He hinted that it was likely that the rotation itself is the cause of the main part of both magnetic fields—in which case it may be possible to develop a general theory that will enable us to compute the magnetic forces which act on the surfaces of the other planets or even on the stars.

Stewart of Princeton (who has contributed to these columns) starting from the general properties of atoms and electrons, showed that an ionized gas, such as must exist in the atmospheres of the sun and stars, will be nearly transparent to light, so long as it is of low density. The electrons will be set into vibration by the electric forces which accompany the waves of light, but this will cause only a slight scattering of the light, such as is produced by the molecules of air in our own atmosphere. But when the density is greater, and collisions between electrons and atoms become frequent, energy will be transferred in increasing measure from the vibrations of the electrons to the other motions of electrons and atoms, and the light will be absorbed while the gas will be heated. It appears that a gas as dense as ordinary air, and at the sun's temperature, must be practically opaque in a layer a mile or two thick—and, looking from above as we do, we cannot hope to see down into its mass (though it is purely gaseous) even to the level where the density equals that of air. The lower layers will appear like a dense fog, when observed on the scale of our telescopic images. This furnished an explanation of an old puzzle—why the sun, though so very hot that no known substance could condense into liquid or even into clouds on its surface, nevertheless shows a sharp edge, and clearly defined details; and it has the great advantage that, being derived from general considerations, and not at all from mere solar observations, it applies to the stars in general, as well as to the sun.

Kiess, of the Bureau of Standards, has unravelled many of the complexities of the multilined spectrum of chromium, and obtained information regarding the processes which occur within its atoms when these lines are produced—information which will greatly aid in the interpretation of the behavior of these lines in the spectra of the stars.

The Size of the Universe

Meanwhile, the students of the older astronomy have not been idle. Wilson, of the Dudley Observatory at Albany, has derived proper motions for a large number of short-period (or so-called Cepheid) variable stars, and has thus obtained their average distance. The results confirm the conclusion previously drawn from a much smaller number of stars, by Shapley and others, and support strongly the belief that our sidereal universe extends to enormous distances—although suggesting that the earlier specific estimates require diminution by perhaps 30 per cent, leaving the Galaxy some 200,000 light-years in diameter, which is fairly roomy.

Joy, from Mount Wilson, reports very remarkable observations of the spectrum of the long-period variable Omicron Ceti (or Mira) at minimum. The familiar spectral lines fade out, and almost disappear, though the bands due to titanium oxide are still strong, while a new spectrum is revealed, strong in the violet, with bright lines of hydrogen and helium. This spectrum, alone, would be attributed to a very hot and bright star; but it clearly belongs to the variable, which is fairly near us in space and, at minimum, is much fainter than the sun. What it means no one knows at present and it may take a deal of work to get a clue. These long-period variables with their enormous fluctuations in light—ranging in some cases from fifty times the sun's brightness down to a mere five per cent of the sun's luminosity—are among the least understood of astrophysical phenomena and we are still in that early stage of discovery when each new fact is unexpected and surprising.

Menzel of Princeton, discussing the measures of Coblentz and Lampland on the heat radiated from the planets (of which we spoke a few months ago) showed how difficult it is to arrive at reliable estimates of planetary temperatures. The worst trouble is, much of the heat from the planets is lost in getting through our atmosphere, and this loss depends on the humidity, not only near the observatory, but in all the miles of air above, where it is very hard to determine it accurately. In spite of these difficulties, one conclusion at least appears very probable; the surfaces of Jupiter and Saturn must be very cold—far below zero, Fahrenheit. Even so, these planets appear to give off a little heat, and more than they receive from the sun (after the loss by direct reflection is allowed for); so they are evidently hot inside, though the heat leaks out but slowly to the surface, and is insufficient to keep it hot (as it was once supposed to do).

At 11 o'clock: Mar. 8
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23

At 9 o'clock: April 7
At 8½ o'clock: April 14
At 8 o'clock: April 22

At 9½ o'clock: Mar. 29

NIGHT SKY: MARCH AND APRIL

The Heavens

But we must turn from this scientific gossip to our monthly glance at the skies. The splendid winter constellations are now sinking in the west. Taurus, Orion and Canis Major are close to the horizon, while Auriga, Gemini and Canis Minor hang above them. Leo is high in the south, with the sickle almost on the meridian, and south of the zenith—matching the dipper which is to the northward. Hydra stretches its huge length across the southern sky, and Virgo fills a large space in the southeast. Boötes is well up in the east, with Corona and Hercules below and to the left. Draco and Ursa Minor are seen in the north-northeast, while Cepheus, Cassiopeia and Perseus lie along the horizon in the north and northwest.

The Planets

Mercury is a morning star this month, but is south of the sun and poorly placed, rising about 5.40 A. M. on the 1st, and not far from the same hour for two weeks following, after which he gets nearer the sun and is lost to sight.

Venus is a morning star, past her greatest brilliancy, but very conspicuous. She rises shortly after 4.30 A. M. all through the month. With the telescope, she appears like the moon a couple of days past the first quarter and only of about half the diameter which she showed in January, because she is farther away.

Mars is an evening star in Aries, setting at 8.45 P. M. in the middle of the month. He is on the far side of the sun, nearly 200 million miles away, but even so he is much brighter than any star in the neighborhood and is a conspicuous object.

Jupiter is in Libra and rises about 11.30 P. M. on the 1st, and 9.30 on the 31st, by which time he is prominent in the late evening. Saturn is in Virgo, approaching opposition, which occurs next month; he rises about two hours before Jupiter.

Uranus is in conjunction with the sun on the 5th, and is invisible. Neptune is favorably placed, just past opposition. On the 1st he is in 9h. 14m. 48s., + 16° 10′; and on the 29th in 9h. 12m. 30s. + 16° 21′. He is in the eastern part of Cancer, remote from any good sky-marks, and can be found only with an equatorial telescope.

The moon is full at 10 P. M. on the 2d, in her last quarter at 2 P. M. on the 9th, new at 8 A. M. on the 17th, and in her first quarter at noon on the 25th. She is nearest the earth on the 4th, and farthest away on the 19th. During the month she passes near Saturn on the 5th, Jupiter on the 7th, Venus on the 13th, Mercury on the 15th, Uranus on the 16th, Mars on the 21st, and Neptune on the 28th. None of these conjunctions is remarkably close.

Eclipses occur at both new and full moon this month. The lunar eclipse, on March 2, is only partial, about three-eighths of the diameter being obscured on the northern side. The time is convenient for observation in the eastern United States, the first contact with the shadow coming at 9.28 P. M., eastern standard time, the greatest phase at 10.32, and the last contact at 11.36.

The solar eclipse on March 16 is annular, and of long duration—nearly eight minutes at maximum. The annular phase is visible over a track about 170 miles wide, which extends from Patagonia across the south Atlantic into Africa, crossing Rhodesia and passing later over Madagascar. The partial phases are visible throughout South America below latitude 17° south, and in all Africa south of the Sahara, but nothing at all of any phase of the eclipse can be seen in any part of the United States or Canada.

Finally we may note that, at 10.29 A. M., on March 21, the sun crosses the celestial equator, and "spring commences."

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Chemical Processes

PLASTIC COMPOSITION FOR FLUSH TANKS.—J. G. LOCH and C. DI BATTISTA, c/o W. E. Elmes, attorney, Berwick, Pa. The invention relates to a waterproof, tough and stiff plastic composition for making flush tanks. The composition consists of sulphur 50-80 parts, pumice stone 10-20 parts, pulverized sand, 1-10 parts, magnesium carbonate 1-5 parts, fibrous material 1-3 parts, and a coloring material to suit. The various ingredients are mixed dry and slowly heated.

Electrical Devices

CONTROLLING AND REGULATING SYSTEM FOR DYNAMOS.—W. J. RICKETS, 32 Torrens Road, Brixton Hill, S. W. 2, London, England. The invention relates generally to controlling and regulating systems for dynamo electric devices to effect a substantially constant voltage at and above certain critical speeds, and under varying loads. More particularly the device relates to a thermionic means of effecting the control and regulation of dynamo electric machines.

SWIVEL CONNECTION.—D. L. SAUERHERING, Wausau, Wis. An object of this invention is to provide a simple effective swivel connection for use in electric light and other cords to obviate twisting and tangling and in particular to obviate kinking and breaking. A further object is the provision of a device in which pulling strains will be taken up through means clamped to integral portions of wire sections apart from the connected extremities of the wires.

Of Interest to Farmers

LISTER PLOW.—A. PFEIFFER, Box 42, Kingsville, Texas. Among the objects of the invention is to provide means for working all the land, doing away with hard strips and thus enabling the land to hold much additional moisture, and to provide means for allowing some of the broken earth to fall back into the furrow, thus covering practically all the land with loose soil. Another object is to provide a plow that will shed the soil readily.

Of General Interest

CLOTHES LINE SUPPORT.—J. S. DAVIS, 316 Chestnut St., Albion, Mich. This invention relates particularly to a support for use in drying rooms, the primary object being to provide a device of this character which will facilitate the supporting of a maximum length of clothes line in a minimum amount of space, so that there will be no waste space in the drying room. A further object is to provide a support which will be exceedingly simple and durable in use.

BURGLAR ALARM.—A. D. MARCOTTE, 934 Pearce St., Memphis, Tenn. The object of the invention is to provide a device which may be mounted on any door or window of a building and adapted, by means of a cartridge-firing mechanism, to cause an explosion when an intruder attempts to open the door or window. A further object is to provide a device which is simple in construction, positive in operation and may be quickly applied. (See Fig. 1.)

BOTTLEHOLDER.—R. B. MITCHELL, 211 15th Ave., Homestead, Pa. This invention relates to bottleholders adapted for use with milk bottles. The object is to provide a holder with which a bottle may be readily associated or from which it may be readily taken and which at the same time securely supports the bottle suspended free of contact with surrounding structures, the mouth of the bottle and the associated parts being protected so as to preserve it in a sanitary condition.

KNEE PAD.—P. H. RYLANDER, 1000 E. 6th St., Austin, Texas. It is a purpose of this invention to provide a knee pad which includes a container constructed to removably receive cushioning material and to hold the material out of direct contact with the knee, and at the same time to provide a resilient seat for the knee. A further object is the provision of a pad in which the rigidity of the ordinary fastening straps is eliminated, and flexibility provided, so that comfort is given to the wearer whether kneeling, standing or walking.

SHIP SPEED INDICATOR.—R. STAR, 253 Bergen St., Brooklyn, N. Y. An object of the invention is to provide a simple yet accurate construction wherein the indicating dial may be easily placed at any point on the boat or ship regardless of whether the vessel moves through the water at high or low speed. Another object is to provide an apparatus wherein means are provided for taking care of any loss in transmission and thereby cause the indicating pointer to always correctly show the exact speed.

PERCH SUPPORT.—V. C. POTTER, c/o C. D. Potter Co., Stamford, Conn. Among the objects of the invention is to provide a means for supporting a perch, either attached to a wall or the floor, which will positively prevent lice from crawling up to the perch, cups being provided on the supports, just below the perch itself, for receiving any suitable insecticide for trapping the lice which endeavor to reach the perch.

POT COVER.—E. F. RITTER, R. F. D. No. 1, Somerville, N. J. This invention has for its object to provide a form of pot cover which will prevent the contents of the pot from boiling over, with the inconvenient consequence of losing part of the material which is being cooked and soiling the stove. The cover is formed with a central opening normally closed, but counter-balanced to respond to the steam pressure within; should the contents boil over they will drain back into the pot through the opening.

TOILET SEAT.—E. F. RITTER, R. F. D. No. 1, Somerville, N. J. The invention is primarily intended for use with chemical toilets and other forms of commodes. An object is to provide means associated with the seat for normally concealing the contents of the bowl, and to provide means whereby a weight on the seat moves the concealing means to inoperative position. The device is simple in construction and unlikely to get out of order.

KEY POCKETBOOK.—L. KALINA, 384 Alabama Ave., Brooklyn, N. Y. The invention pertains to keyholders of the enclosed type. Among the objects is to provide a device in which the keys are kept free from dirt, and so constructed that money or other articles in the same pocket will not be accidentally withdrawn upon the removal of the keyholder. A further object is to so construct the holder that when it is opened the keys will be automatically withdrawn from the receptacle.

WATCHCASE.—L. LUBIN, 15 Park Row, New York, N. Y. An object of the invention is to provide a movement frame which snugly fits within the watchcase and which supports the movement and is capable of ready removal from the watchcase to facilitate access to the movements for repair without the necessity of removing the movement from the frame.

REVOLVING PICTURE FRAME.—I. STARR, 2073 Mapes Ave., Bronx, N. Y. The invention contemplates the provision of a form of base upon which any conventional type of picture frame may be mounted for rotation, the frame being open at both sides to expose two pictures and mounted for turning movement to expose either of the pictures.

GARBAGE RECEIVER.—I. J. FROST, 183 Beacon Hill Ave., Lynn, Mass. An object of the invention is to provide a garbage receiver adapted to contain garbage cans, which may be placed in the ground so that its upper surface will be level therewith. A further object is to provide a receiver provided with a perforated bottom to allow the escape of any water, but also adapted to prevent rats from entering. The cover of the receiver is spring acting and may be moved by the foot.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. The invention relates more particularly to a method of retaining a powder compact in operative position within the vanity case. It is a further object to so construct the retainer, which comprises a resilient metallic band, that the powder compact carrier may be removed from the vanity case at will.

SAFETY LID FOR TANKS.—A. B. FACCIANO, Rosario De Santa Fe, Argentina. The invention consists of providing the ordinary screw covers of naphtha or gasoline containers, with a locking device requiring a special key, in order that after the lid has been adjusted in position the lock will be operated, and nobody will be able to remove the lid without the use of the key.

CALENDAR.—W. H. BAKER, 1001 E. 9th St., Newton, Kans. The general object of this invention is to provide a calendar composed of three discs, these discs having years, months and days imprinted thereon, the discs being actuated from the front side of the calendar. A further object is to provide a device which is relatively simple in construction and which may be used for a number of years.

BEDPAN.—FLORENCE A. WOOD, 2122 E. 100th St., Apart. 9, Cleveland, Ohio. Among the objects of the invention is to provide a pan having means for supporting the legs of the patient and for preventing an overflow of the contents, thereby preventing the soiling of the bed clothes. A further object is to provide a pan having maximum capacity for its given dimensions and being capable of a thorough and easy cleansing.

PHONOGRAPH.—E. A. WATSON, P. O. Box 864, Mill Valley, Calif. The principal object is to provide a sound-producing machine that automatically begins to operate when the record is placed on its seat and that automatically stops when the last groove of the record has been reached. A further object is to provide a mechanism by which the sounder carrying the needle automatically finds its right place for records of different sizes.

SCREEN FRAME.—R. J. BURHEN, 907 S. 22d St., St. Louis, Mo. This invention particularly relates to the frames of window screens, the object being to provide a knockdown frame which may be quickly erected, which will be ornamental in appearance, which will obviate the necessity of fastening members, corner braces, and other additional parts, which will bring about a true level between the surfaces, and provide for the effective connection of the screen cloth.

HAIR CURLER.—GERTRUDE B. BATTERSBY, 4635 Sanson St., Philadelphia, Pa. The invention is primarily intended for use in curling bobbed hair, but will also prove efficacious in waving longer hair. An object is to provide a curler which will be exceedingly simple and practical in construction, strong, durable and efficient in use, and easily manipulated, the whole curler being formed from a single piece of metal.

RAPID TOWEL HANGER.—F. PHILIPPE, SR., Box 3, South Charleston, W. Va. The general object of this invention is to provide a device for the indicated purpose of few and simple parts and whereby a towel or the like may be clamped in position with facility and readily removed. The device includes spring-pressed jaws mounted on a common pivot at their upper ends, the lower ends presenting opposed gripping surfaces. (See Fig. 2.)

COIN TILL.—J. D. PETTIT, 1967 Carmen Ave., Hollywood, Cal. The general object of this invention is to provide a coin holder or till adapted to hold coins of various denominations in stacks and constructed and arranged to promote strength with simplicity of construction and so arranged as to promote convenience in the placing and removal of the coins. (See Fig. 3.)

LIFEBOAT.—C. BERTSCHERT, 373 William Ave., Winnipeg, Manitoba, Canada. This invention aims to provide a lifeboat which shall be capable of accommodating a large number of persons, capable of being maneuvered by the occupants, extremely seaworthy, and in which the necessary amount of air will be permitted to enter. A further object is the provision of a lifeboat which may be readily accommodated upon the deck of a vessel, and which in the event of the vessel foundering will float clear of its supports.

PURSE.—H. RIUS and J. M. FONTANALS, address J. M. Fontanals, 1206 Fifth Ave., New York, N. Y. The general object of the

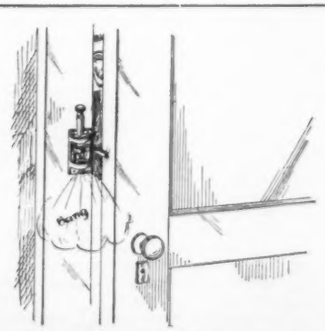


Fig. 1. An ingenious burglar alarm worked by the opening of a door, the invention of A. D. Marcotte

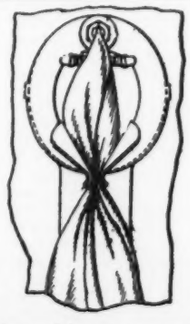


Fig. 2. This handy towel hanger, ever ready for use, is the invention of F. Philippe

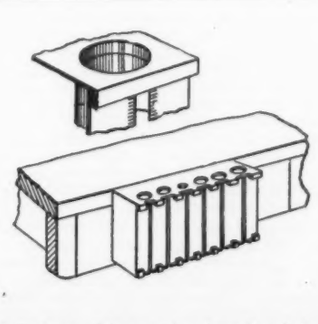


Fig. 3. J. D. Pettit claims greater strength and simplicity for this coin till which he has invented

invention is the provision of a novelty purse, sewing bag or the like, having means provided in conjunction with the bag for giving the same the appearance of a dressed doll. A further object is the provision of means for so associating the decorative means with the bag that the former may be easily removed, so that access to the bag may be had.

GRAVITY AIR CIRCULATOR.—J. B. LACY, 11007 Church St., Chicago, Ill. An object is to provide a gravity air circulator for refrigerators in which the air is cooled and delivered at a point adjacent the ceiling of the room, thus permitting the cooled moving air to fall directly upon the contents of the room. A further object is to provide a construction by means of which a relatively small current of warmer air is admitted, the echo of the warmer air striking the cooling coils is such that only a minimum deposit of frost is left upon the pipes.

METHOD OF MAKING A LEAD-COATED COPPER SHEETING. — A. KLEIN, 415 East 34th St., New York, N. Y. Among the objects of the invention is to provide a lead-coated copper sheeting whereby all the beauty, antique and weathered appearance of lead for use on buildings, in the shape of gutters, leaders, etc., may be retained and at the same time retain all the good qualities of copper where used for the aforementioned purposes.

WRITING IMPLEMENT.—J. F. HUME, 436 Hopkins Ave., Astoria, N. Y. The invention is particularly devised with a view to providing an implement capable of utilization by school children, in teaching them to write, but not necessarily limited to this adaptation. The implement includes a spherical body formed with a transverse bore and sleeve adapted to be positioned within the bore and means associated with the sleeve end for permitting a writing element being attached thereto.

SANITARY PAD FOR WATER CLOSET SEATS.—H. H. SOMMER, 1703 Regent St., Madison, Wis. An object of this invention is to provide a sanitary pad that is adapted for adjustment to a water closet seat to comfortably cover the same to prevent contact of any portion of the seat with the user. A further object is to provide a device of the type described which can be folded to fit within and be ejected from a vending machine.

EYE WASHING DEVICE.—F. MAIER, 231 Niles Ave., Elizabeth, N. J. Among the objects of the invention is to provide an eye washing device arranged to permit of accurately directing a jet of water or medicated liquid onto any particular point of the eye ball, and to provide a firm mounting of the cups to securely hold the device on the user's face to form a non-leaking joint around the eyes, the cups may be used together or singly.

HEEL.—G. C. SEYMOUR, 18 East 49th St., New York, N. Y. The invention relates to a removable heel section. An object is to provide a rubber heel section and associated parts whereby the rubber section readily interlocks with the remaining part of the heel when in use, but permits a quick and easy assemble; the rubber heel is capable of adaptation to a large or small heel either of leather or wood.

FILE ENVELOPE.—R. J. WEINACHT, 366 Amsterdam Ave., New York, N. Y. This invention aims to provide a file including a number of elements which may readily be associated with each other and which will further be of such a construction as to be capable of being readily detached from the file unit so as to be capable of being carried in the user's pocket. The device is extremely simple and capable of construction at a minimum cost.

OILER CASE FOR SAFETY RAZOR BLADES OR THE LIKE.—J. W. GUICE, 1727 No. Western Ave., Los Angeles, Calif. The object of this invention is to provide an oiler case by means of which a safety razor blade may be covered with a film of oil in an expeditious and thorough manner. The oiler comprises a pair of lids, one being adapted to fit upon the other, an oil absorbing pad carried by each lid adapted to embed a razor blade between when the lids are placed one upon the other.

LUMINOUS INDICATING BUTTON FOR KEYS.—H. LEVEY, Room 1824, Woolworth Bldg., Broadway, New York, N. Y. An object of the invention is to provide a simple, economically manufactured luminous button which can be readily applied to various articles, such as keys, whereby the attachment to and detachment from the key or article is made extremely simple so that the buttons can be readily replaced when desired. The device will render the operation of the article, extremely simple in the darkness.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. Among the objects of the invention is to provide a vanity case, the body of which is divided into two compartments, and having a removable bottom plate with means whereby the plate automatically locks itself within the case upon its insertion. The bottom and partition may be used in an ordinary vanity case, for holding securely different cosmetics, and to permit their removal without disturbing the case.

AUTOMATIC FIRE ESCAPE.—H. VIEREGG, 220 West 1st St., Grand Island, Neb. The invention has for its object the provision of means whereby in escaping from a fire a person need merely attach the device to some suitable support and then grip a rope, whereupon his weight effectively operates the device, at the same time causing a regulation of the movement of the rope to prevent the speed of descent from being too great, this being accomplished by the provision of a centrifugally operated braking means.

METHOD OF EMBOSSED PRINTING. —D. G. ELSEN, 116 East 24th St., New York, N. Y. Broadly the invention relates to a method of embossed printing on fabric or other flexible material whereby the embossing and the imposing of the ink thereon is accomplished simultaneously. As a further object the invention contemplates a method in which the embossing is accomplished by means of a heated element and in which dry ink is employed which liquefies under the action of heat.

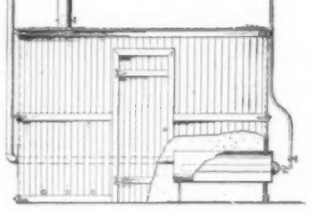


Fig. 4. This portable drier, shown installed, is the invention of T. F. Ballister and H. Goedinghaus

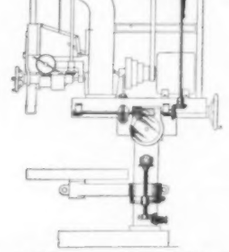


Fig. 5. A drill press, the invention of J. E. Carlson, with a wide range of work

SCREEN.—R. H. HAWLEY, 3783 Washington St., Kansas City, Mo. The invention relates to a screen for the grading of materials and refers more particularly to that type of screen employed in separators and actuated by jarring or vibration to cause the material to be screened to readily pass therethrough. The invention particularly relates to a means for suspending the screen cloth within a frame, and to permit of its ready removal and replacement therein.

SWING.—O. H. FISHBURNE, 691 Fulton St., Brooklyn, N. Y. The invention has particular reference to lawn swings of the oscillatory type. An object is to provide means for mounting and supporting the swing body upon the base to cause the body to move in an accurate path upon reciprocations of the same whereby to simulate a swinging action. A further object is to provide simple means operable by the occupants of the swing for effecting reciprocations of the same.

HOLDER.—ISOBE TUDOR, 35 Hawthorne St., Brooklyn, N. Y. The aim of this invention is to provide a device more particularly adapted for use in connection with an extraneous body, or pad of material, such as steel wool, acid soap, and similar elements utilized for scouring and general cleansing purposes. A further object is to provide means by which an operator may readily manipulate such a pad without injury to the hands.

CLEAN-OUT DEVICE FOR PITOT TUBES.—J. COYNE, 773 Montclair St., Squirrel Hill Station, Pittsburgh, Pa. One of the principal objects of the invention is to provide a means, useful in boiler plants, for associating the Pitot tube with a conduit or supply pipe which permits of the examination, removal and cleansing of the Pitot tubes without the necessity of cutting off the passage of the steam, gases, liquids or other fluids through the conduit or supply pipe in order to save time, labor and expense necessitated in cutting off and draining the conduit.

ENCRUSTED METAL DESIGN ON CERAMIC SUBSTANCES AND PROCESS OF MAKING SAME.—E. WARRIN, 49 Wooster St., New York, N. Y. An object of the invention is to provide a process for decorating ceramic substances which may be broadly classified as follows: covering the article to be etched with an acid resisting composition except where it is desired to have the design etched by hydrofluoric acid. Coating the design with a metallic paint composition. Firing the composition into the design. Electroplating copper on the design, and electroplating the design with gold.

TELEPHONE SET.—F. E. GALLAGHER, R. D. Box A23, Santa Clara, Cal. The invention has reference more particularly to the receiver and receiver hook. The purpose is to remove the objectionable noise which occurs and is transmitted to the person having the receiver to their ear when the party on the other end of the line hangs up, by insulating and covering the receiver hook or the receiver or both so that the receiver is brought into contact with the hook it will be a silent contact and the disagreeable noise thus obliterated.

BRUSH.—R. E. CLEVELAND, 1312 Broadway, Oakland, Cal. The invention relates to a brush to be used in connection with a wash bowl having an outlet in its bottom. The principal object is to provide means by which a person having only one hand can conveniently wash the same without the assistance of another person. The brush having a handle adapted to engage the outlet of the wash bowl.

Hardware and Tools

TOOL HANDLE. — J. V. WOODWORTH, 205 E. 5th St., Los Angeles, Calif. The principal object of this invention is to provide an all-metal handle for files or similar tools, adapted to be slipped on the shank of the same and to be firmly held there by a spring action imparted to the handle. The handle may be easily slipped on the tool shank and will firmly hold the same, and when removed may be used again.

GUTTER HANGER.—C. MEUNIER, Middle Neck Road, Great Neck, N. Y. An object of the invention is to provide a device which is primarily adapted to be attached to the side wall of a building, and at a point below the edges of the roof thereof, and which will support the gutter in such manner as to preclude any danger of the latter being turned from its fastenings or the latter being torn from their support incident to the reception of sudden strains such as occur when snow and ice slide from the roof and strike the gutter.

CYLINDER BORING DEVICE.—L. A. KREJCI, 1523 West 18th St., Chicago, Ill. Among the objects of the invention is to provide a device for boring or reaming cylinders that has means for centering a boring bar or spindle with respect to the inner wall of the cylinder and for maintaining the bar in adjusted position while permitting free functional movement thereof, and means for controlling the longitudinal movement of the boring bar, whereby uniformity and accuracy of the cut may be assured.

GARDEN TOOL.—Z. T. CLARK, 902 Pacific St., Portland, Ore. The invention has reference more particularly to a curb trimmer. The object is to provide a simple and inexpensive tool that can be used in trimming the edges of lawns, flower beds and walks. It can also be used for removing sprouts or limbs from shrubbery or vines and for extracting deep-rooted weeds from lawns.

GUTTER HANGER.—C. MEUNER, c/o L. M. Wolf, 110 West 40th St., New York, N. Y. It is an object of this invention to provide a hanger primarily intended for supporting a gutter, and by means of which a supporting element will be provided capable of ready association with the member to be supported. A further object is the construction of a device which will provide all the adjustments necessary to the proper hanging of the gutter.

Heating and Lighting

DRIER.—T. F. BALLISTER and H. GOEDINGHAUS, c/o Santa Maria Cleaning and Dye Works, Santa Maria, Cal. The invention relates to driers and deodorizers especially adapted for use in the dry cleaning industry, and laundry work. An important object is to provide a drier which is portable and may be conveniently set up and bolted together in any desirable place. A further object is to provide a drier of simplified construction, which overcomes the necessity of employing a boiler and the machine fittings usually employed, the device being heated by a special gas burner. (See Fig. 4.)

GAS HEATER.—A. T. BROCH, Box 425, City Hall Station, New York, N. Y. Among the objects of the invention is to provide a heater which will consume a comparatively small amount of gas and at the same time, will give forth an intense heat, which is constructed in such a manner that air is first heated by being directly exposed to the flame and then super-heated by passing over the surface which has been previously heated by the flame.

DRIER.—L. E. MILKEY, Box 1251, Sandusky, Ohio. The invention relates to a paper and fabric drier employing a drying vacuum system in which the sheet of paper or fabric is maintained out of contact with any hot metal surface. A further object is to provide a drier in which heated air is sucked through the sheet during its movement on the periphery of a suction drum and while it is confined in a casing, without scorching or in any way injuring the article to be dried.

SHOVEL STOKER.—G. A. W. REVERMANN, Utrecht, Netherlands. The invention has for its object to improve known type of shovel stokers to render them practical for ordinary water tube and fire tube boilers. The improvements are directed particularly to the manner of mounting and operating the dished shovel for the effective charging of the furnace and the effective distribution of the fuel in the furnace, as well as to make the interior of the furnace more readily accessible for inspection.

COMBINATION ELECTRICAL HEATER AND COOKER.—M. BUTCHER, 152 Dalton Ave., Fernie, B. C., Canada. The primary object of the invention is to provide a simple and cheap appliance of the character described which may be conveniently used for either cooking or heating purposes, and embodying a unique co-related number of parts which enable the same to be neatly packed for portable purposes and also enable the same to be quickly and easily changed to a heater or cooker.

Machines and Mechanical Devices

DRILL PRESS. — J. E. CARLSON, Box 422, Edgewater, N. J. The invention relates to a drill press or machine of a similar nature. The invention aims to provide a drill press which shall be constructed in its main elements in the usual manner, but which shall embody certain simple requirements of construction rendering the machine capable of accommodating any size of work. By use of this invention a conventional size or even smaller size drill press, at only a minor additional cost, is capable of operating upon various types of work. (See Fig. 5.)

CLOTH-ROLL-STAND ATTACHMENT FOR LOOMS.—A. B. SMITH, c/o J. P. King Mfg. Co., Augusta, Ga. The object of the invention is to provide a stand or holder by means of which a roll of cloth may be temporarily supported in an elevated position after being removed from the loom and await the haulers, and thereby eliminating the possibility of the cloth becoming soiled or otherwise damaged by lying upon the floor.

MOTOR ATTACHMENT FOR WRINGERS.—C. A. WINTER, 577 5th Ave., New York, N. Y. The invention has for its object to provide an arrangement whereby a

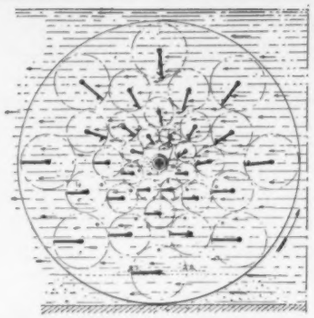


Fig. 6. A simple form of water motor operating below the surface, invented by D. G. White

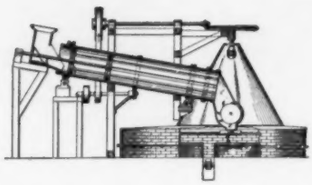


Fig. 7. E. D. Deeter's apparatus for the better distillation of carbonaceous materials

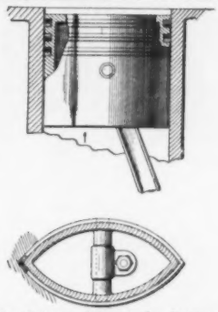


Fig. 8. Small-bore, long-stroke internal-combustion engine with oval cylinders, developed by A. J. Krause

power motor may be connected to a wringer of any type without changing the wringer. A further object is to provide a power member adapted to be quickly connected with a wringer and constructed to provide a reversing action which may be easily manipulated for causing the wringer to act in substantially the same manner as if hand driven.

BLOCK AND TACKLE APPARATUS.—R. S. RODIER, 322 E. 201st St., Bronx, N. Y. The invention is primarily designed for use in connection with hoisting apparatus. The object is to provide a simple and efficient block and tackle system that may be used as a single block system for handling light loads and as a double block system for handling heavy loads without altering the reeving of the blocks.

LOOM PULLEY HUB.—A. P. GREER, Greenville, S. C. In the operation of looms the periodical strains born by the main crank shaft serve to loosen the connection between the drive pulley and the crank shaft. An important object of this invention is to provide means to compensate for this rapid wear on the crank shaft and the drive pulley so that the necessity of frequently replacing the various parts associated with the crank shaft is overcome.

WINDMILL.—G. VAIL, Emerado, N. D. An object of the invention is to provide a wind wheel having a horizontal bearing and a vertical pivot, a pair of blades on each end of the wheel, the blades on one end, when the wheel is in operation, being located below the horizontal plane of the horizontal bearing, and the other pair of blades being in a plane above the horizontal bearing. A further object is to provide angularly disposed blades or vanes, and counterweights on one blade of each pair.

BELT CALCULATOR.—G. R. FICKERT, 513 Bloomfield St., Hoboken, N. J. The general object of the invention is to provide a simple device for calculating the proper length of belting when the measurement over the pulleys is known. The object is accomplished by providing a circular scale representing feet, and in conjunction with this scale a plurality of scales representing inches of belting to be cut to allow for stretch.

FLUID-CURRENT MOTOR.—D. G. WHITE, Braddock Heights, Md. The invention relates to water motors. The object is to provide a motor which operates to develop the maximum power from the flowing body of water in which it is immersed irrespective of the direction of flow of the current, which may be readily reversed without impairing its efficiency and which is in general of simple and durable construction, reliable in operation and easy to maintain. (See Fig. 6.)

APPARATUS FOR CUTTING VALVE FACES.—E. B. SHERK, 715 N. 5th St., Lebanon, Pa. Among the objects of the invention is to provide an apparatus for supporting and rotating a valve in the presence of a cutting tool, means for rendering the same adjustable to accommodate valves of various sizes, and for cutting various angles on the valve face, and means for varying or regulating the pressure of the valve against the cutter to obtain a fine or coarse cut.

METHOD OF AND APPARATUS FOR THE DISTILLATION OF CARBONACEOUS MATERIALS.—E. D. DEETER, Miami, N. M. The invention relates to a method of distilling carbonaceous materials, especially materials which are solid or semi-solid in character. This apparatus includes a retort, a rotatable cylindrical shell positioned with its axis inclined to the horizontal, means for introducing material into the upper end of the shell, and a rotatable element adapted to deliver the material from the shell into the retort, said rotatable element being also adapted to prevent the passage of vapors evolved in said retort through the shell. (See Fig. 7.)

CENTRIFUGAL CASTING MACHINE.—F. ELLIS, U. S. National Bank Building, Salem, Oregon. An object of this invention is to provide a casting machine such as are principally used by the dental profession in casting inlays, clasps, crowns, bridges and the like. A further object is to provide a centrifugal casting machine in which the rotating shaft is pivotally mounted in spring-actuated means for rotating it so that the shaft may continue to spin after the tension of the spring has been exhausted.

EYE TESTING MACHINE.—H. D. REESE and J. M. HARLESS, address J. M. Harless, Gulfport, Miss. The principal object of the invention is to provide a machine which is extremely simple in operation. It is also an object to provide a testing machine which may be easily operated by the person whose eyes are being tested. A further object is to incorporate the machine with a cabinet so that the same can have an artistic housing.

POWER GENERATING AND TRANSMITTING MEANS.—M. A. FLACH, Comfort, Texas. The invention relates more particularly to an apparatus having means for driving a plurality of household articles such as a churn, a meat chopper, various kinds of household mills, ice cream freezers and the like. An important object is to provide means whereby a single motor and power transmitting means may be employed, and may be readily connected to the various articles.

ROTARY PUMP.—A. BEARDSLEE, P. O. Box 153, Great Falls, Mont. The primary object of the invention is to provide a pump of the centrifugal type for pumping liquids, which is of compact and simple construction, and particularly one in which the friction parts may be lubricated to reduce friction to a minimum and prolong the life of the pump.

VALVE.—C. C. WILLIAMS, Superintendent Water and Light Department, Bloomington, Ill. The invention has for its object to provide a valve especially adapted for use as a gate valve in water supply systems, and the like, wherein the stem of the valve is subject to corrosion and to the collection of incrustations, and to provide a means for opening and closing the valve by moving the stem longitudinally without any turning movement, which is liable to twist off the steam.

MOUNTING.—F. SCHWANHAUSSER, c/o Rusling Wood, 218 William St., New York, N. Y. The invention aims to provide a device which is intended more particularly for use as on mounting adapted to support a projecting machine. An object is to provide a mounting which may be disposed upon a supporting surface, which is subject to the usual amount of vibration, but which mounting will incorporate structure capable of absorbing to the greatest degree all shocks and tremors.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—A. J. KRAUSE, 1408 East 25th St., Cleveland, Ohio. The invention relates more particularly to that type of motor commonly known as a small-bore, long-stroke motor, the primary object is the provision of oval-shape bores with their direction of greatest diameter at right angles to the crank shaft, whereby with a small bore a much longer stroke will be permitted than that of which the usual bore and piston are capable. (See Fig. 8.)

VALVE SPRING LIFTING DEVICE.—A. LOVELESS, Box 546, Aberdeen, Wash. The purpose of the invention is the provision of a valve lifting device by means of which one or more valve springs can be readily compressed to disengaging position with respect to the valve seat pins, and maintained in such position without necessitating the manual holding of any portion of the device so that the operator's hands are free to withdraw the pins.

LINER FOR CYLINDERS.—E. B. MOOMAW, c/o Moomaw Machine and Tool Works, Kansas City, Mo. The invention relates to cylinders for engines, pumps, or the like, the purpose being the provision of a liner by means of which a scarred, cracked or broken cylinder can be restored to complete usefulness. The liner for engine cylinders consists of a sleeve threaded throughout for threaded engagement with the bore of a cylinder, and securing means, such as a plastic composition, arranged in the spiral threaded space.

LIQUID PUMP.—A. F. VAN AMSTEL, Amersfoort, Netherlands. The invention relates to a liquid pump for internal combustion engines and is characterized in that the discharge or outlet valve of the pressure space of the pump is not hydraulically but mechanically operated inwards with respect to the pressure space, and that the operation of opening the outlet valve is performed in the interior of the pump by means of the pump piston or plunger or other liquid-displacing member.

STEAM ENGINE.—P. H. DARRAH, c/o Genl Delv., San Mateo, Cal. The primary object of the invention is to provide a steam engine of the rotary type which will be simple in construction and operation, and in which the rotor is confined with freedom of rotation and with annular guide rings on the inside circumference of the casing received in annular grooves on the outer circumference of the rotor.

SPARK-PLUG CLEANER.—E. KEIEL, c/o Smith-Has Engine Company, Dayton, Ohio. One of the objects of the invention is to provide means, in the form of air pressure, by which a cleaning medium such as kerosene or the like may be precipitated into contact with the electrodes of a spark plug to remove carbon or other deposits therefrom. A further object is to provide a device which is readily portable and capable of use wherever a source of compressed air is available.

Railways and Their Accessories

FLANGE OILER.—C. N. POND, 120 Bench St., Galena, Ill. An object of the invention is to provide a simple device for feeding a lubricant to the flange of a locomotive steam engine. A further object is to provide an automatic flange oiler that is adapted to be secured to an engine of any ordinary construction without change of the latter being required, whereby the lubricant is fed to the flange at a point parallel with the axis of the wheel to which applied and in substantially the same horizontal plane.

RAIL JOINT.—J. B. MURRY, Wilmington, Ill. An object is to provide a rail joint in which the downward pressure of a railroad car wheel in passing over the junction of two sections of rails is counterbalanced by an upward pressure upon the ends of the rail sections. A further object is to provide a device in which the greatest part of the weight of the car passing over the rail joint is carried by the thickest part of the rail base. The device may be readily applied to rail tracks of ordinary construction.

TRAIN STOP MECHANISM.—G. P. HORAN, Rutland, Vt. The invention relates more particularly to a guard for the valve or cock of the train air line, an object being to provide mechanism which prevents the operation of the valve by contact with snow, which protects the valve from stones or other objects on the track, which permits the operation of the valve when the plunger designed to operate the same is in position, but which is shielded from accidental operation.

AUTOMATIC RAILROAD CROSSING GATE.—J. R. GOLDEN, 320 Truman St., Hammond, Ind. This invention has for its object the provision of a device which will automatically lower the gates upon the approach of a train, and raise the same after the train has passed. Another object is the provision of a gate electrically connected with a device, upon the passing over of which by a train, the gates will be lowered as the train approaches the crossing, and raised after the train has passed the crossing.

TRACK CONSTRUCTION.—D. C. MONAHAN, Warren, Ill. An object of the invention is to provide splice-plates for securing rails together without the use of separate bolts and nuts. Another object is to provide a means of securing rails together having relatively few parts, all of which are interchangeable and adapted to engage the rails in standard holes as provided in the web of the rails.

SYSTEM OF AERIAL RAILWAYS.—J. D. ROOTS, 58 Avonmore Road, West Kensington, London, W. 14, England. Among the objects of this invention is to provide a method and means for an aerial railway especially for crossing arms of the sea or straits that it is impossible to bridge. An object is to provide towers or masts, and a steel cable stretched between them. The cable not being intended to carry a load, but to act as a guide way for a special form of airships.

Pertaining to Recreation

TOY ANIMAL.—A. GUND, c/o Gund Manufacturing Company, 35 East 19th St., New York, N. Y. The object of the invention is to cause a toy animal to emit sounds on pressing and quickly releasing it while resting on a table, floor or other support, and to cause the toy animal to assume first a crouching position and then a forward jumping position. A further object is to provide a toy which is simple, durable and not liable to get easily out of order.

TOY.—E. H. TUNLEY, c/o Tunley Machine and Tool Works, 814 Gates Ave., Brooklyn, N. Y. The invention relates to power driven toys. The primary object is the provision of a driving medium which shall be extremely economical and simple in construction, aside from the fad that the liability of breakage or disarrangement of the parts is reduced to a minimum. Another object is the provision of a toy which shall be pleasing in appearance, and fascinating to children.

AMUSEMENT DEVICE.—B. FINAZZO, 155 Bradford St., Brooklyn, N. Y. This device, in general, comprises a supporting framework on which one or more pivoted oscillating platforms are mounted. These platforms are connected by suitable means to a power source, and a passenger car arranged at the ends of each platform, the rocking platforms move up and down, the cars rotating in one direction and another

upon their axes, thus giving a very unique resultant motion.

AMUSEMENT DEVICE.—M. S. MAMOULIAN, 1014 E. 179th St., Bronx, N. Y. The general object of the invention is to provide a device that will afford amusement especially to a group of young people and which will be a source of merriment by displaying an infinite variety of combinations, items of information, topical contributions, a simulation of fortune telling, or the like, in a diverting manner.

Pertaining to Vehicles

DRAWBAR COUPLING FOR TRACTORS.—W. A. MUELLER, Aberdeen, S. D. The object is to provide a bar by which a plow or other draft appliance may be coupled to a tractor in an easy and expeditious manner, the said coupling being adapted to automatically release the tractor from the draft appliance upon a predetermined resistance being offered by the draft appliance to being drawn by the tractor.

VEHICLE CHASSIS.—P. N. RAWSON, George School, Pa. A purpose of the invention is to provide a chassis by means of which the transmission of all irregularities in the surface of a highway to the body of a vehicle is prevented and in such manner that the vehicle body or other parts of the vehicle will be subjected to no tortional strains or stresses, and will not rock under a shifting load, and does not rely on springs for its flexibility.

RIM TOOL.—C. and W. HIBBARD, care Hibbard Gas Engine Works, Hudson Falls, N. Y. This invention relates to tools for automobile tires, and is designed as a means for facilitating the association and disassociation of tires and rims, in a simple and efficient manner. As a further object the device affords means for compensating for the deflection of the ends of the rim at the joint where the same have been bent or otherwise distorted to normally be out of true alinement.

VALVE LIFTER.—C. F. and F. O. LENGFELD and J. J. MCHUGH, 1309 Steiner St., San Francisco, Calif. The invention relates to a valve spring lifting device intended principally, although not exclusively, for use in connection with Ford automobiles. The principal object is to provide a device by means of which four valve springs may be lifted at a time and which will interfere in no way with the operations necessary for the removal or the grinding of the valve, and has no working parts below the valve spring seat, thus does not offer any obstacle to the fingers of the operator in extracting the pin supporting the seat.

RESILIENT WHEEL.—D. S. KENNEDY, 457 East 167th St., Bronx, New York. The general object of the invention is to provide a wheel efficient in affording resiliency while possessing the maximum stability, and to provide a wheel wherein the deformation of the resilient elements at a given point under an imposed load or due to shock, will be widely distributed circumferentially of the wheel. The invention provides an inner rim adapted to be mounted on a wheel, an outer tire rim, and springs between the inner and outer rims.

COMBINED WAGON AND AUTOMOBILE DUMP.—F. J. LEECH and W. H. MYERS, Ottawa, Ill. The invention relates to vehicle dumps of the type in which the wheel supports for the vehicle are adapted to assume a position for tilting the vehicle body and in which provision is made for receiving and dumping either a wagon or an automobile truck. The device is characterized by a novel form and arrangement of means for controlling the tiltable elements provided for dumping an automobile or those tilting elements provided for dumping a wagon.

CHAIN TIGHTENING AND LOCKING DEVICE.—V. KUBELKA, 89 McDougal St., Brooklyn, N. Y. An object of the invention is to provide a novel form of lever mechanism which is primarily adapted for use in connection with tire chains, and a device which will serve to securely lock the ends of a chain together as well as stretching the same tightly around the tire so that there is no danger of its slipping off.

MOTOR MOUNTING.—T. H. FIELD, c/o Field Automobile Company, Rice Lake, Wis. The aim of this invention is to provide a form of motor mounting in which primarily the universal joints will be eliminated so that the attention heretofore necessary to these parts may be dispensed with, secondly the invention is of such a character that the full power derived by the motor will be transmitted to the rear axle.

HAND TRUCK—Z. ADAMS, 16 Rivington St., New York, N. Y. The invention aims to provide a hand truck in which means will be provided permitting a single stevedore to handle an article with relative ease, which article may be of an extreme weight. A further object is to provide a device which will preclude the possibility of the article carried becoming dislodged, while the same is being moved, and to enable the operator to properly manipulate the truck while the same is being loaded and unloaded.

DEMOUNTABLE RIM.—E. G. GEHRLICH, Fountain City, Wis. One of the principal objects of the invention is to provide a simple, effective and convenient means for securing the rim to the felly which requires only the removal of a single locking nut to permit of the demounting of the rim. The device is adapted to be used in connection with standard rims and fellies now in general use without materially altering the same.

DIRECTION SIGNAL.—I. R. JOHNSON, 1059 Third Ave., New York, N. Y. The general object of the invention is to provide an automobile signal adapted to be mounted at the sides of the vehicle adjacent the driver's seat and each including a manually operated semaphore to be optically operable to conspicuously indicate that the vehicle is about to turn to the right or to the left, a lighting means is provided to be utilized at night.

RIM AND TIRE CONSTRUCTION.—H. E. A. LANDSMAND, 264 10th St., Hoboken, N. J. An object of the invention is to provide means permitting the changing of an inner tube without removing a tire from a rim or a rim from a felly. More specifically, an object is to provide a semi-pneumatic tire which uses a plurality of inner tubes, any one of which may be removed and replaced without disturbing the position of the tire shoe on the rim.

BICYCLE SADDLE TRUSS AND SEAT-POST CLAMP.—R. G. BAILEY, 111 East San Fernando St., San Jose, Calif. The object of the invention is to provide a saddle truss which includes in combination a seat-post clamp made of one rigid piece and provided at its rear end with means for adjustment in connection with the rear saddle spring which obviates the necessity of employing a plurality of springs. The device is adapted to be connected with different types of saddle springs, and permits the required tilt of the saddle.

VEHICLE WHEEL.—A. B. FUHR, c/o City Court, Macomb, Ill. This invention relates to a wheel primarily designed to prevent dust and dirt from entering between the sides of the wheel and the tire and lodging in spring means which resiliently support the felly. An object is to provide a device which resembles the ordinary disc wheel in construction, but which is readily assembled, and not likely to easily get out of order.

SNOWPLOW.—L. E. ADAMS and C. C. PECK, c/o Board of Alger County Road Commissioners, Munsing, Mich. An object of the invention is to provide a construction which may be applied to trucks, tractors, or any suitable motor vehicle, and which may be connected to and arranged and supported principally by traction members engaging the ground while connected to the vehicle in such manner as to be pushed readily along. The device provides a V-shaped plow member and deflecting wings whereby a comparatively wide swath is cleared at one operation.

SPRING SUSPENSION FOR VEHICLES.—A. E. THORNE, c/o MacNabbs Apt., 310 West 55th St., New York, N. Y. The object of this invention is to provide a spring suspension for automobiles, autotrucks and other vehicles, arranged to insure easy riding in the vehicle and to reduce side skidding to a minimum. Another object is to permit the use of solid tires on the rear wheels, and at the same time insure as comfortable riding as if the vehicle were equipped with pneumatic tires and shock absorbers. (See Fig. 9.)

DEMOUNTABLE RIM.—H. M. HOWELL, address Instant Changeable Tire Rim Company, Monroe, La. Among the objects of the invention is to provide a rim adapted to be utilized in conjunction with a spare tire pumped up and ready for service, which may be readily mounted or demounted from any type of wheel, and which permits of the removal and replacement of the tire on the demountable rim without the necessity of pinching the tire over the tire retaining flange.

AUTOMOBILE LOCK.—C. GERBEN, 235 East 235th St., New York, N. Y. The invention has for its object to provide a construction which will be neat and strong and at the same time effectively lock certain operating parts of an automobile against movement. A further object is to provide a lock in which the locking mechanism is operated through the use of a traveling member associated with a key actuating lock mechanism.

CONVERTIBLE AUTOMOBILE BODY.—J. J. MCGUIRE, 21 Sherman Ave., Yonkers, N. Y. Among the objects of the invention is to provide a convertible body, more particularly adapted for use in connection with motor vehicles, and by means of which a number of standard bodies may be formed within a short time, so that the user may have available, in a single motor vehicle a limousine or sedan type of body, a coupé, roadster, or touring car body which will incorporate a "stream-line" appearance conforming to the modern types of bodies.

ACCELERATOR.—H. SMITH, Grand View, Putnam, Conn. An object of the invention is to provide means whereby an accelerating device may be actuated either directly by plunger action, in the usual manner, or by a sliding action in a predetermined gradual manner by the driver of the car. A further object resides in the provision of means whereby this accelerator can be applied to any type of car with a minimum alteration of the structure of the car. (See Fig. 10.)

LUBRICATING SYSTEM.—P. H. GASKINS, 1207 Graham Bldg., Jacksonville, Fla. The object of the invention is to provide a lubricating system which maintains a film of oil or other lubricant between all of the relatively movable parts of the shackle connection of the spring suspension, thereby reducing wear, eliminating noise and insuring even, smooth and easy action of the shackle connection. The system is extremely simple, and durable in construction.

CLUTCH HOLDER.—F. F. WUNDER, Valley Falls, Kan. The invention relates to devices which are adapted for attachment to a tractor to engage a clutch control lever of the tractor to releasably hold the latter in position to occasion the releasing of the driving connection between the engine of the tractor and the transmission thereof, without disengaging the gears of the transmission. A further object is to provide a clutch holder which comprises but a single piece of resilient material. (See Fig. 11.)

FOLDING GO-CART.—A. N. FLEURY and C. F. MAYER, 4 Bedford Avenue, Brooklyn, N. Y. Among the objects of the invention is the provision of a go-cart including means which renders the same readily foldable into a small and compact article, whereby the same may be transported in folded condition in railways, automobiles or public conveyances. A further object is the provision of means for locking or retaining the vehicle in its set-up or its folded positions.

VELOCIPEDE.—J. HUDRY, c/o P. G. Heidenrich, First National Bank, Hazleton, Pa. The invention relates to a velocipede adapted to be converted from one type of vehicle into another. The general object is to provide a velocipede involving a chain and sprocket drive and in which provision is made for adapting the chain and sprocket drive either to a single rear wheel in a plane approximately at the medial line of the vehicle or to a pair of rear wheels disposed at opposite sides of the medial line. An important object is to provide ball bearings in the frame parts of the machine.

BRAKE FOR SELF-PROPELLING VEHICLES.—F. H. RICKER, 1711 Scott Ave., Los Angeles, Calif. The object of the invention is to connect the main drive shaft of a motor vehicle with a circulation system so that the shaft drives a pump, causing a medium to circulate in the system and to provide suitable means within the system for stopping the circulation whereby the pump as well as the shaft is rendered inactive. A further object is to provide a specially designed valve for the purpose of rendering the obstacle in the circulation system variable.

Designs

DESIGN FOR A GLOVE GAUNTLET.—J. RICE, c/o Wimelbacher & Rice, 30 Union Square, New York.

DESIGN FOR LEATHER, SKIN, FABRIC, OR ARTICLE OF SIMILAR NATURE.—P. SILVERMAN, 181 Lafayette St., New York, N. Y.

DESIGNS FOR TEXTILE FABRICS.—C. E. LORD, c/o Galey & Lord, 25 Madison Ave., New York, N. Y. This inventor has been granted patents on eleven ornamental designs for textile fabrics.

DESIGN FOR WALL PAPER.—P. K. WAGNER, c/o Standard Wall Paper Co., Hudson Falls, N. Y.

DESIGN FOR A TOY ANIMAL.—L. MYERS, 108 E. Fulton St., Gloversville, N. Y.

DESIGN FOR FLAT LINEN.—H. GOULD, 550 Hackensack Plank Road, Union Hill, N. J.

DESIGN FOR A TABLE TOP.—P. J. HIGGS, 11 E. 54th St., New York, N. Y.

DESIGNS FOR TEXTILE FABRICS.—C. E. LORD, c/o Galey & Lord, 25 Madison Ave., New York, N. Y. The invention has been granted patents on nine ornamental designs for textile fabrics.

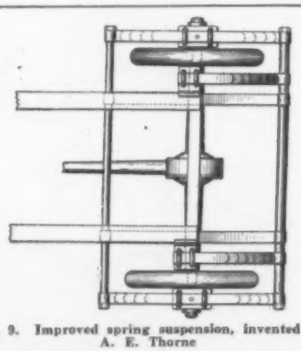


Fig. 9. Improved spring suspension, invented by A. E. Thorne

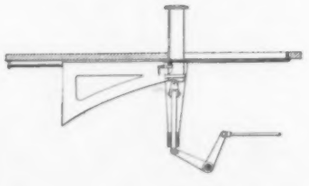


Fig. 10. Accelerator pedal of greater flexibility than the standard pattern, invented by H. Smith

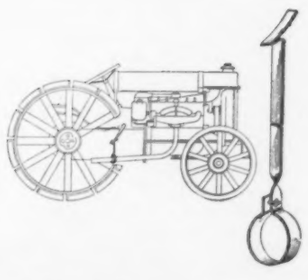


Fig. 11. Clutch-holding member for tractor, designed by F. F. Wunder

Coffee with a College Education

Science Pronounces Coffee a Safe Stimulant

By James H. Collins

PEOPLE have been drinking coffee at least ten centuries for two reasons: First, they like its flavor and aroma.

Second, it is mildly stimulative—has a "pick-up" without a "kick" that increases the capacity for either brain or muscular work.

But there are still new things to be learned about coffee. Three years ago a "scientific coffee research" was inaugurated at the Massachusetts Institute of Technology, financed jointly by the coffee importers, roasters and distributors of the United States. The purpose of this organization is to give the public better knowledge of coffee, break down prejudice due to popular misunderstanding of its physiological effects, and help people get the beverage at its best.

Feeding a rabbit dry coffee and sugar at Massachusetts Institute of Technology

"Tell us the best way to make a cup of coffee," said the coffee men. "And give us the scientific facts about coffee as a stimulant."

No "Tannin" in Coffee

This research was begun by Professor Samuel C. Prescott and his assistants in "Tech's" Department of Biology and Public Health. Professor Prescott is a bacteriologist, and his fellow workers in the investigation are Dr. R. L. Emerson, a physician and chemist, and Professor John W. M. Bunker, biochemist and physiologist. A digest of the voluminous coffee literature showed that it was contradictory even in strictly scientific matters, such as chemical analyses of coffee. New analyses failed to reveal certain ingredients in the high percentages recorded by previous investigators, and in the case of one important property long attributed to coffee failed to reveal it at all. Much has been written about tannin in coffee and its effect upon delicate digestions, but nothing of the gallotannic acid type has been found in this research. Which means that coffee will not tan like oak bark. When scientists disagree to that extent, little wonder that cooks disagree about the best way to make coffee beverage, or that there should be erroneous popular notions about its healthfulness.

What Is the Ideal Cup of Coffee?

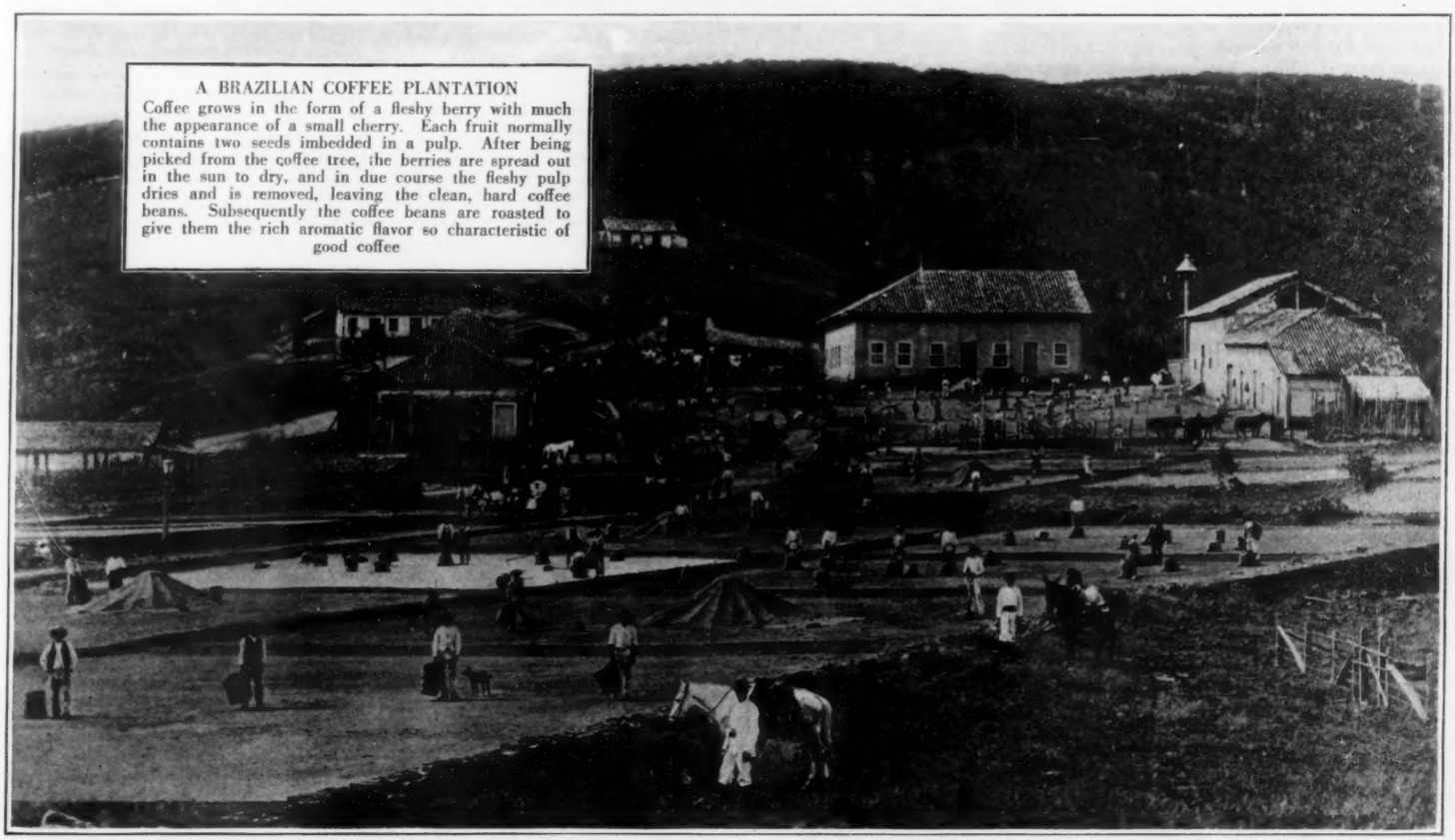
After digesting the literature, new studies were made of the coffee bean to find the right way to make the best possible or "ideal" cup of coffee. The coffee bean holds more things than the layman suspects. There is a lot of fibre in it, some chaff, from .6 to 2.2 per cent of caffein, 2 to 3 per cent of aromatic and volatile oils, and a miscellany of fats, waxes, resins, glucosides, and so forth. Some of the things in the bean, like its oils, in combination with other ingredients give well-made beverage coffee its delightful flavor. Others are bitter or astringent.

Now, to make the ideal cup of coffee it is good science and good sense to extract the pleasant things from the bean and leave the unpleasant ones behind. Boil coffee, and you get its bitter ingredients along with its bland oils—and a flavor of tin if you use a tin coffee pot, or a flavor of silver, aluminum, copper, or almost any other metal with which the beverage comes in contact. Coffee should not be boiled, and is improved when divorced from metal.

After many experiments, the following laboratory method of making coffee was devised. Water is first boiled in a glass vessel, and allowed to stand a minute or two, dropping down to 200 degrees Fahrenheit or less. Then freshly ground coffee is put into the water, stirred with a glass rod until all the particles are wet, when they sink, and the coffee is decanted off the grounds, giving an infiltrated beverage that has body enough to satisfy people who like the strongest coffee, and yet with a delicacy of flavor that delights the most sophisticated and exacting coffee-lover.

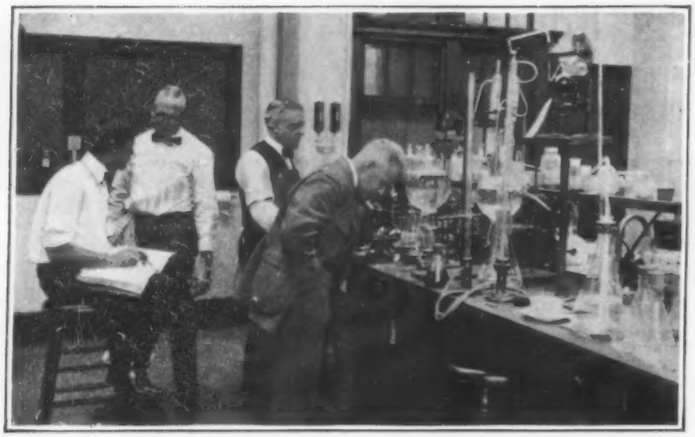
A Referendum Vote on the "Best Coffee"

Is this the best possible cup of coffee? The investigators think it is, and have abandoned other ways of making coffee, using this in their homes. They have also submitted their beverage to a referendum vote. For months those interested in the progress of the research, sitting down to lunch, have had free coffee served them, several cups per person, each numbered—coffee with cream and sugar, coffee without, coffee boiled, coffee percolated, coffee made in this new way, coffee made in tin, aluminum, copper, glass.



A BRAZILIAN COFFEE PLANTATION

Coffee grows in the form of a fleshy berry with much the appearance of a small cherry. Each fruit normally contains two seeds imbedded in a pulp. After being picked from the coffee tree, the berries are spread out in the sun to dry, and in due course the fleshy pulp dries and is removed, leaving the clean, hard coffee beans. Subsequently the coffee beans are roasted to give them the rich aromatic flavor so characteristic of good coffee



In the Coffee Research Laboratory, Prof. S. C. Prescott, Director of the Research, at the right, using the microscope

"Sample all of them and tell us what you think is best—and second best, and which is the worst," said the investigators.

These blind tests have demonstrated that while coffee made as above described does not strike everybody as "best," it pleases four persons out of five, and is pronounced the best cup of coffee oftener than any other brew.

"This is the first time I have ever had coffee that tastes as freshly ground coffee smells," is the way many persons express it. There are always a few in any group, however, that vote for boiled or percolated coffee, or coffee made in a metal utensil.

"That is because you are accustomed to the taste of coffee made a certain way," declare the investigators. Substitute scientifically made coffee a few mornings, and not many persons want to go back to other kinds.

While it may not be practicable for the housewife to make coffee by an exacting laboratory method, the main principles developed by Professor Prescott and his assistants are not difficult to follow. The most important thing is that coffee should never be boiled—that is, the coffee bean and water should not be boiled together. This new study of the bean has shown that it contains certain bitter and astringent elements which boiling extracts, and which most people dislike in beverage coffee. The investigators suspect that other changes take place, but as yet are not prepared to say just what they are. The fact that boiling injures the flavor is sufficient reason, in their opinion, for using some other method.

The method they have worked out resembles what the housewife knows as the drip or filter process. Most of the best hotels and restaurants use a modification of this method, putting the coffee into a muslin bag or metal sieve covered with filter paper and pouring the hot water through the grounds, not letting the water and grounds boil together or even remain in contact more than a few moments. It is simple enough, after you know the principles. It is even possible to make excellent coffee by supporting a muslin bag over the mouth of a pitcher, putting in the desired amount of ground coffee and pouring the hot water through slowly. As a matter of practice, the housewife who uses the drip method should *start* with boiling water because the contact of water with the cold grounds will bring the temperature to that point below the boiling point, which Professor Prescott has found best for perfect extraction.

Caffein a "Safe" Stimulant

Caffein is one of the "quick" elements in the coffee bean—fully 80 per cent dissolves from ground coffee in two minutes in water at 185 degrees. This is the most characteristic principle in coffee, the source of its stimulating power. The great majority of coffee-lovers would miss it if absent. Many of the greatest intellectual workers have been great coffee-drinkers, finding mental alertness in its small percentage of caffein. This being also the principle that is most frequently suggested as an objectionable constituent, a thorough study of caffein has been carried on at the Boston "Tech" to determine its effects upon normal people. The investigators have gone far enough to pronounce caffein a safe stimulant, and say that it can be taken by the vast majority of healthy grown folks without subsequent narcotic or depressing effect if used in moderation, not abused. In this verdict the scientists make no reservations regarding any special ways of brewing.

As part of this research, experiments are being made on rabbits with both coffee and caffein. Rabbits were chosen because they are animals of fair size, reasonably easy to obtain, and can be studied more easily than larger animals. In diet they are natural vegetarians, and also decided conservatives, sticking pretty closely to the kinds of food they know. Yet rabbits quickly learn to drink coffee with plenty of cream, and eat ground coffee sweetened with sugar. Their tolerance for caffein without discernible bad effects has been found very high—so high that, on a basis of comparative weight, to get the same amounts of caffein in beverage coffee, a human being would have to drink daily, not cups, but gallons.

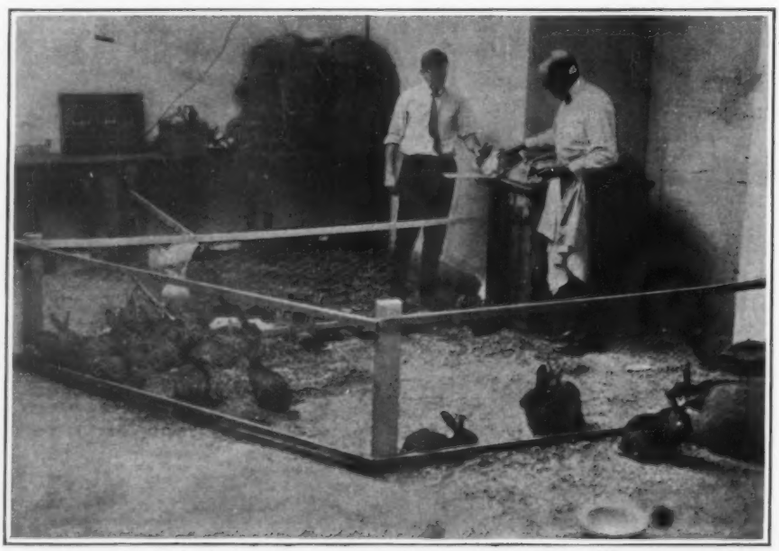
"We have found that the amount of caffein a rabbit will tolerate at one dose varies with the body weight and with the environmental factors of food, physical condition, etc., just as is the case with the human animal," say the investigators. "It can tentatively be assumed on the basis of our work that the tolerance of a rabbit for caffein is more than 1.5 grains of caffein per pound of body weight. This amount is about the equivalent of that in an average cup of coffee. This amount, aside from the temporary disturbances due to the large amount of liquid in the stomach, does not affect their subsequent feeding or apparent health."

Dr. Emerson putting caffein in the rabbit's feeding bowl

Not "Habit Forming"

For most normal people, caffein is a mild heart stimulant, increasing mental concentration and the capacity for either brain or muscular work, followed by no undesirable reaction except in excessive amounts. It has been compared to the foot accelerator on an automobile. Step on the "gas," and the car gains speed, falling back to normal when the foot is lifted. The normal person drinking coffee as a stimulant to get extra work from the brain or body, taps a reserve of energy without paying the penalty of subsequent depression. The pernicious stimulant not only forms a habit very difficult to break, but increasing amounts must be taken to produce the desired effect, whereas the coffee drinker gets refreshment and stimulus from the same number of cups daily, year after year.

Coffee-lovers and coffee-makers will be interested by some other conclusions reached in this research. For instance, water has long been considered a factor in making good coffee, some kinds of water being a fine vehicle for flavor, while others impair it. Thus far, different kinds of ground and surface waters in New England show little variation, though very hard or alkali water might injure flavor. The experiments will continue, but water is considered subordinate to other factors in coffee-making. Cream and sugar have been found to bring out the flavor of coffee sharply in the group tests, as compared with black coffee. This is undoubtedly due, however, to the fact that the great majority of persons are accustomed to coffee with sugar and cream or milk. Individual taste plays a very important part in coffee. Some persons have a keen taste perception, while in others taste is not acute. Furthermore, many people are likely to be influenced by and are partial to coffee as they have decided it is best, either in the mode of making, the blend, or the way of serving. On that account, the referendum of personal opinion in group tests was relied upon in determining flavor and aroma. *—Advertisement.*



Improvised rabbit hutch in a vacant room adjoining the Coffee Research Laboratory

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Obviously, this has promoted a national community of every-day interest which characterizes no other nation in the world. It has given the people of the whole country the same kind, if not the same degree, of interest in one another as the people of a single city have. It has made necessary facilities of national communication which keep us in touch with the whole country and not just our own part of it.

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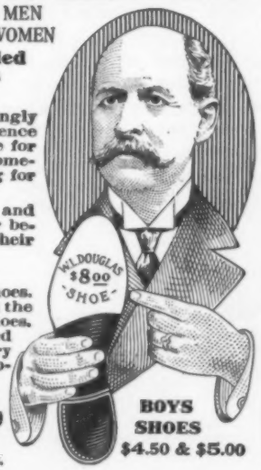

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Science Notes

Our Government as a Volcano Owner.—The United States now owns about one-quarter of all the volcanoes in the world. There are about 417 active volcanoes and we possess 106 besides hundreds of smoking peaks.

Yellowstone Park is Fifty Years Old.—The semi-centennial of the creation of Yellowstone Park as a national monument will be celebrated on June 18. Congress passed the bill creating the park on May 1, 1872.

Titian Home as a Monument.—The house at Pieve di Cadore in which the great painter Titian was born has been proclaimed a national monument by the Government, as has the birthplace of the poet and dramatist Count Vittorio Alfieri at Asti.

The Curie Fund Oversubscribed.—From the fund collected by the women of America to present a gram of radium to Mme. Curie, there remains, after about $110,000 had been paid for the radium, a surplus of about $50,000, the annual income from which will be given to Mme. Curie.

A Button Museum.—In Prague will be found the Waldes Museum devoted to a collection of dress-fastening devices of all kinds and of all ages. It was founded by a Bohemian button manufacturer, and is filled with thousands of curious devices. This is one of the most curious special museums in Europe.

Berlin Zoo Closed.—The Berlin Zoo facing bankruptcy was forced to close through the winter, but it was hoped that funds could be secured so that it could open again in March. Some fears are entertained for the consequences of the winter's economy arrangements, since the herding of various types of animals together will be necessitated.

The Hunting of Meteorites by Mail.—This may seem a novel method of searching for rare meteoric finds, but it has proved to be efficacious. The Curator of Geology of the U. S. National Museum corresponds with the nearest postmaster to a reported find, and the latter is usually able to put him in touch with persons who can give reliable facts.

Wrist Watches Said to Be Poor Timekeepers.—Paris jewelers have their repair departments clogged up with wrist watches. They state that no watch will stand a jigsaw life indefinitely. They also say ordinary watches must not be laid on a cold marble bureau top during the night, as is the habit of thousands for watches require a certain amount of warmth afforded by bodily heat in the daytime and a cloth protection at night.

Franklin's First Philadelphia Home to Go.—Benjamin Franklin's first Philadelphia home is to be wiped out of existence. The house at 111 Spring Street, where he took up his residence upon his arrival from Boston, is to be torn down, along with numerous others, to provide for the approach to the new Delaware River bridge. The house is a ramshackle, tottering shanty, and the street on which it is situated is only an alley. The Curator of Independence Hall plans to preserve the windows and panels of the old structure, all being splendid examples of Colonial craftsmanship.

The Peopling of Asia.—Dr. Ales Hrdlicka, the distinguished American ethnologist, contributes to the Proceedings of the American Philosophical Society an important paper on the peopling of Asia, which "constitutes one of the greatest problems of anthropology." He concludes that the cradle of humanity was essentially southwestern Europe, with, later, the Mediterranean basin, Western Asia, and Africa. It is primarily from Europe and secondarily from these regions that the earth was peopled, and this peopling was comparatively recent. Early man was unable to people the globe owing to his insufficient effectiveness, and until the end of glacial times and his old stone culture he had evidently all he could do to preserve mere existence. Only an advance in culture could enable him to control his environment and secure a steady surplus of births over deaths. The cause of man's peopling of the world was not a mere wish to do so, but the necessity arising from growing numbers and correspondingly decreasing supply of food. It was this which eventually led to agriculture. This spreading over the globe was conditioned by three great laws—movement in the direction of least resistance; movement in the direction of the greatest prospects; movement due to a force from behind, or compulsion.

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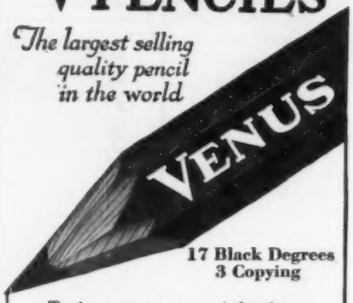

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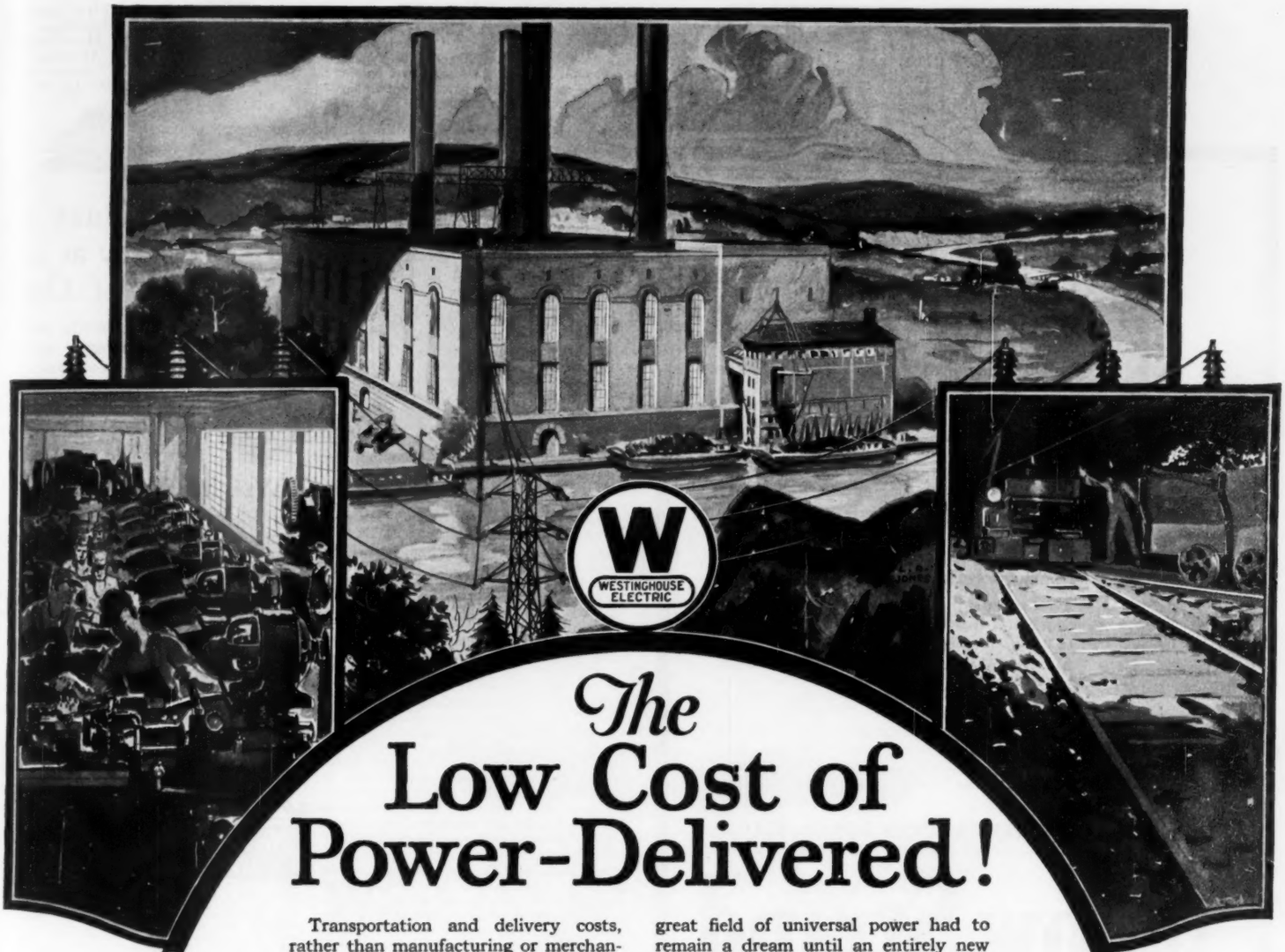

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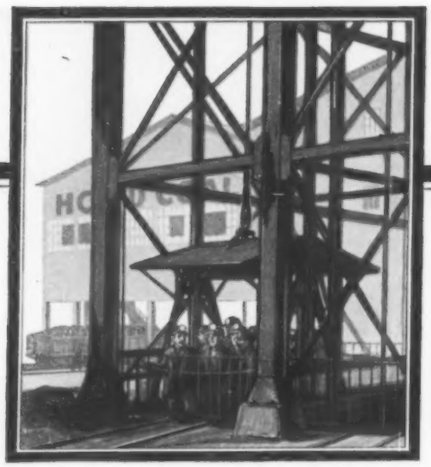

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Science Notes

Getting Around the Finger Print.—Finger prints have proved the downfall of many criminals. Burglars have been using collodion on their hands to prevent leaving telltale finger prints and it works, for a short time ago one gang in New York plundered ten stores and escaped in a short space of time.

Radium From Parsonite.—Parsonite, a new radium bearing mineral found in the Belgian Congo, was described lately to the Academy of Sciences in an address written by the Belgian Professor Shoef. The paper told of the success that is being met with in extracting radium from the mineral at a special laboratory in Antwerp.

A New Alloy Simulating Gold.—A young French chemist named Mazarin has invented a new alloy resembling gold and it has been called "areum." It has the brightness, durability and inoxidability of gold, which qualities will permit its substitution in jewelry and other manufactures where gold is now used. No particulars as to composition seem available.

Red Color in Solar Salt and Brine.—A note in *Science* calls attention to a possible cause of the red color in solar salt and brine. Recent investigations tend to indicate that the color is due to micro-organisms that thrive in a media containing not less than 15 per cent of salt by weight, and one in which the most favorable temperature is between 50 and 60 deg. Centigrade.

Sir William Osler's Bequest.—Embalmed in a casket, the heart of the late Sir William Osler, famous physician, will be placed in the Osler library at McGill University upon its arrival from England. The heart, as well as a medical library of several thousand volumes, were bequeathed to the university by the physician. Special quarters in the new medical building have been set aside for the bequest.

"Too Previous" Stamps.—Two of the Leeward Islands which Columbus discovered —St. Christopher and Nevis—are British possessions and, of course, have distinctive stamps. A recent issue shows woful ignorance of astronomical lore for Columbus is shown with a spyglass although Columbus died more than 100 years before Zachariah Haussen devised the telescope if the credit is not be given elsewhere. The early history of the telescope is very hazy.

Our Decaying Historic Records.—The danger of disintegration of priceless documents of the United States Government was revealed recently, when Assistant Secretary Rose of the Senate found the time-ravaged records of the first session of the Federal Congress in an unlighted, musty room beneath the terrace of the Capitol. The condition of the records was said to indicate that unless properly cared for they would fall to pieces in a few years. The Monroe message had been kept in the files of the Senate, and when taken out was so brittle it threatened to fall apart if opened. It was placed in the hands of experts, who will attempt its preservation.

The Most Deadly Poison.—Experiments carried on at the Harvard Medical School indicate that the poison produced by the bacillus of botulism is very much more deadly than prussic acid, although fortunately it is not so rapid in operation. The poison occurs very rarely, but when it does usually several persons eat the food and are killed by it. The germ that produces the poison was discovered by a Belgian investigator in 1896. In 22 years there have only been 150 cases of illness from this cause, but 111 persons have died from it. Sausages formerly were supposed to be the chief cause of botulism. In the cases of the last few years other foods have been involved, including string beans, cottage cheese, corn, asparagus, ripe olives and spinach. It also has been attributed to turkey, chicken and fish. While the victims frequently show the symptoms in from 16 to 18 hours, they do not always develop before 36 hours. Weakness, dizziness, headache and nausea first make their appearance. There is difficulty of vision. Patients sometimes see double. The eyelids often droop, and control over them is lost, so that the sufferer can see only by lifting them with his fingers. These effects flow from the attack of the poison on a particular brain center. Other brain centers become involved. Swallowing becomes difficult. The muscles controlling the voice become paralyzed. The paralysis spreads to the lips, tongue and respiration, and the victim gasps for breath. In the end paralysis of the respiration and the heart becomes complete and there is death.

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"The cushioning effect is also very noticeable especially on our heavy equipment.

"We have been able to obtain around 18,000 miles from the giant *Caterpillars on the rear wheels of our heavy trucks and this is considered exceptional mileage under our working conditions which are very severe and tire-destroying.

"The two tires on the rear of our 1½-ton truck are the first *Kelly Kats used in this county. They were installed something over three years ago and have travelled approximately 30,000 miles and are still going."

This letter is not at all unusual. Indeed it is typical of the letters we are receiving every day from *Caterpillar users everywhere. The combination of traction, resiliency and mileage offered by Caterpillars seldom fails to win the unqualified endorsement of the truck operator who gives them a trial.

**U. S. Government tests show that cushion tires are 50% easier on roads than are solid tires. Caterpillars are an advanced type of cushion tire.*

There is no *Caterpillar Tire but the one that Kelly makes

KELLY-SPRINGFIELD TIRE COMPANY

KELLY KATS — THE TIRES WITH NINE LIVES

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Your trip to Europe.

From the time of wooden ships, through the age of iron to the present one of steel, Cunard Liners have been aptly called the "Favorites" of the Atlantic. The history of Cunard construction, equipment and service, in each epoch throughout four generations, typifies the highest development in the speed, comfort and luxury of transatlantic travel. The present Cunard and Anchor Fleet of magnificent, modern ships (most of them oil-burners) exceeds a million tons.

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Like Putting a New Film in a Camera

PUTTING a "Refill" Shaving Stick into Colgate's "Handy Grip" is very simple, and it is done in a few seconds.

The "Handy Grip" lasts for years. "Refills", threaded to fit it, cost you the price of the soap alone. There is no waste.

In addition to its *handiness* and economy, Colgate's makes a copious lather that softens the beard *at the base*, where the razor's work is done.

With hot water or cold, with soft water or hard, Colgate's lathers quickly, and makes shaving easy. It leaves the face smooth, cool and refreshed.

Send us 10c for the "Handy Grip", the metal container, and a trial-size shaving stick. Then buy "Refills" anywhere, as you need them, for the price of the soap alone. Three months' better shaving in each "Refill", for less than the price of a day's cigars.

COLGATE & CO. *Dept. 40* 199 Fulton St., New York

COLGATE'S "HANDY GRIP"
The Refill Shaving Stick

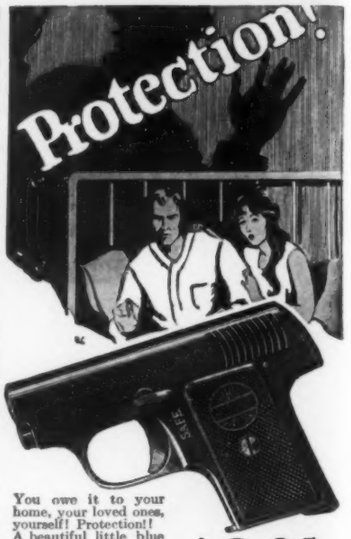
Electrical Notes

The Production of Dry Batteries for 1922 fell some 20 per cent below the 50,000,000 manufactured in 1921. Despite the ever-increasing popularity of bell-ringing transformers and other devices which are taking the place of the usual dry battery, it is said that the dry battery continues to hold its own. Railroads and automobiles use a large number of dry batteries. Just now there is an appreciable demand for dry batteries on the part of radio amateurs, who are using the single dry-cell vacuum tubes instead of the troublesome storage battery heretofore necessary. These amateurs also require high-voltage "B" batteries.

The Largest Turbo-Generator ever constructed in a single unit is now being built by the Westinghouse organization for the new Hudson Avenue Station of the Brooklyn Edison Company. The unit will have a rating of 62,500 kv.-a., three-phase, 60-cycle, 13,800 volts at 80 per cent power factor. The operating conditions for the turbine will be 265 pounds steam pressure, 200 degrees F. superheat, and 29 inches of vacuum. Two 70,000 square foot surface condensers, probably the largest in existence are also being constructed by the Westinghouse organization for this new station. Each condenser will be served by two half capacity circulating pumps driven by two-speed induction motors. The ultimate capacity of the plant will be eight turbo-generator units. Distribution will be at 27,600 volts, instead of at 13,800 volts, as in other New York power plants, because of the difficulty of getting out sufficient circuits with the limited street space.

Increased Use of Asbestos-Covered Wire.—The advantages of asbestos insulation are coming to be more and more appreciated by electrical workers. In the case of electrical machinery, such as motors and generators, the use of the usual silk or cotton insulation limits the temperature to about 100 degrees Centigrade, while with the use of asbestos insulation the temperature may be safely raised to 200 degrees Centigrade, with an increase in output per unit weight of machinery and a marked saving in cost. Asbestos is admirably adapted to electrical work, being available in the form of paper, woven covering, board, molded shapes and so on. Recently an electrical manufacturer has placed a line of asbestos wires on the market which are especially intended for fixtures. This wire is said to be liked by wiremen because it is neat, easy to handle and makes a good job that will stay good. The wire is available in six colors for standard fixture finishes. The asbestos insulation is said to slide through fixtures as if oiled, and will not ravel, fray or deteriorate under heat, even if used with high wattage gas-filled lamps.

Interesting Notes on Electric Flash Lamps.—Two investigators have recently carried out an extensive study of electric flash lamps with interesting results. They have learned that discrimination is necessary in choosing lamps, as the requirements of a night watchman, a motorist, and other users differ considerably. Great variation in the nature of distribution of light in the beam also occurs. In order to obtain a bright uniform central field, gradually shading off at the edges, lamp filaments and bulbs should be symmetrical with respect to axes and filaments should be at a uniform distance from the focus. Tests on flash lamps obtained from eleven manufacturers are summarized in the article appearing in the *Electric Journal*, giving the results of the investigation. Each lamp was lighted for 35 seconds four times an hour and tests were conducted first for eight hours per day and then for 24 hours per day, enabling life to be ascertained. The chief conclusions are as follows: (1) Except in the case of intermittent use long two or three cell flashlights should be used as the greater life more than compensates for the increased cost. (2) No appreciable difference for soldered and seamless batteries in service was noted, but the seamless case is probably superior for long shelf life. (3) Large diameter lenses and reflectors should be avoided except possibly for illumination at a considerable distance. (4) Conical reflectors usually give better light distribution than parabolic ones. (5) More attention should be given to uniformity in construction of lamps; small displacements of the filament from the best position may diminish the candle-power in the axial direction by 50 per cent. (6) Closer co-operation between makers of flash lamps and manufacturers of lamps is desirable.



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$8.25 for 25 caliber 7 Shot Automatic
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Gasoline Camels

(*Continued from page 153*)

and is designed to allow the latter to travel over the most irregular soil, no matter what may be the obstacles, such as rocks or the like, or on the other hand depressions or holes, we will briefly refer to the main principle, without going into any great detail.

The main object is to allow the entire endless belt as a whole, to occupy any angle with the vehicle body, and for this reason the main pulleys are by no means secured to the vehicle, but the whole system is made to pivot about a main axle *B*, which serves as the center point and supports the weight of the vehicle. It will thus be observed that for this reason alone, the caterpillar device is very flexible in its action.

The rear pulley *A* is mounted on an axle which extends below the car, but this axle has a loose mounting so as to be able to rise or descend. On the contrary, the main or middle axle *B* is rigidly secured to the vehicle frame. Upon the end of the axle are mounted the upper and lower spring portions *C* which are pivoted, as will be observed, on the vertical center line of the main axle. At each end, the two spring parts are connected together by a vertical check or link *D*, and this carries at the bottom a pair of rollers *E*, with a pivoted balance arm mounting. In this manner there are two pairs of rollers, or one pair on each side of the main center line. At the front is the second large wheel or pulley *F*, which rests on the ground by its own weight, but without supporting the weight of the car, as it is connected with the main axle only by a bar *H*.

The arrangement as a whole is so constructed as to provide for the greatest flexibility, owing to the rise and descent of the main wheels, or to the varied positions which can be taken by the small rollers, as these cannot only move up and down, but are also tilted in pairs upon their rocker arms in the plane of the vehicle. Two general cases are thus provided for, that is, any sudden upward or downward slopes in the ground, or large obstacles, in which the main caterpillar as a whole will be tilted or pivoted, or again, small obstacles such as individual rocks or the like, and here the small rollers by their flexible movement will allow the rubber belt to yield in the upward direction and to take a sinuous shape which may be quite irregular, for each small roller can move upward for a good distance. It is the ingenious combination of the flexible or pivoting movements that accounts for the great success in traveling upon all sorts of ground, for instance, as in one of our pictures, in which the car is going up an irregular slope, it is noticed that the whole device pivots about the rear axle and makes quite an angle with the vehicle body, and, of course, this angle will depend upon the varying surface of the ground. On the other hand, the small roller combination is especially of use for fitting close upon a curved surface, or for taking small obstacles, such as stones particularly, in which case the belt can take a sinuous shape. It will thus be seen that the car is practically able to travel upon all kinds of ground, and this accounts for the great success it is having in practice.

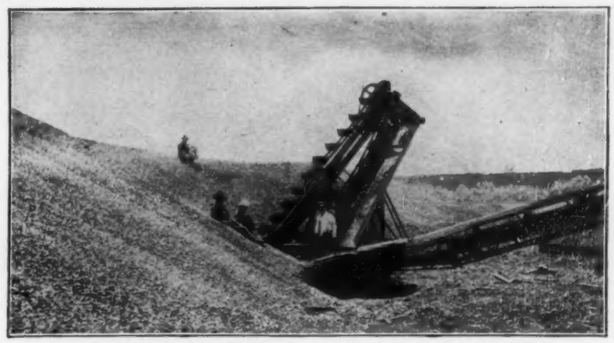
We should add that a change-speed box is provided which gives two geared speeds and a direct drive, the range being from 2 to 20 miles an hour, at an engine speed of 2000 r.p.m., but as the engine can be run at 2500 r.p.m. the speed of travel can be further increased. Should one belt be upon a slippery place and the other on hard or rough ground, the difference in adhesion would cause one belt to slip on the spot in case the effort to be furnished is abnormal (in the same way as for wheels), but the rear axle mechanism has a device for blocking the differential which is controlled by the driver, and the two belts now work together by a solid connection and this provides for the good travel of the vehicle. It should be noted that the main rear axle has a springless mounting and serves properly as a pivot for the endless belt device as a whole.

Where Do Elephants Die?

ONE of the great mysteries of the natural history world is where elephants go when they die. Curiously enough the body of an elephant that has died from natural causes has never been discovered either in India or Africa. Among native races there is a widespread belief that, when the great beasts feel the end approaching, they make their way to some secret hiding place in which to die. The whole question is just as big a mystery as ever, in spite of the

(*Continued on page 214*)

The "Three Per Cent" Law And the Coal Handling Problem



Barber-Greene Bucket Loader and Conveyor handling coal.

How Machine Shoveling Lowers Costs and Takes the Place of Shovel Labor

Any casual inspection of coal pile gangs will indicate the truth of the prevalent statement that "we are absolutely dependent on alien labor to use the shovel."

The so-called "three per cent" immigration law, however, has had the effect of actually diminishing the existing supply of unskilled labor.

In the period ending May 31st, 1922, there was an actual excess of emigration over immigration; nor does there seem to be any believable promise of a basic change in this condition.

The effects are plain in the prevalent increases in the rates for unskilled labor.

They are equally plain in the prevalent tendency to employ mechanical shoveling and handling in place of alien crews.

In as short a time as three months, Barber-Greene equipment of this sort saved $19,000 as against hand shoveling in a Massachusetts plant.

In another plant in the same state a Barber-Greene Bucket Loader (a mechanical shoveler) and Barber-Greene Portable Conveyors eliminated an entire night shift of ten men.

Before one of our engineers had studied the coal-shoveling problem in this particular plant, the night shift and the constant struggle to maintain its strength, were accepted as necessary evils.

After his recommendations were put into effect, the night shift was unnecessary. One man operated the mechanical stoker that they had always used, and the power house payroll was shorter by ten names.

A Barber-Greene Bucket Loader carried the coal from a track hopper directly to the crusher, or else to storage piles. From the crusher it went via a Barber-Greene Portable Conveyor to the stoker—or else to a reserve bin for feeding the stoker.

With this arrangement of equipment four men could unload a 60 ton car in 30 minutes. The loader operated with one helper could put 50 tons through the crusher in 1 hour and 15 minutes. Barber-Greene material handling engineers have achieved similar results for many hundreds of other plants, both large and small, by demonstrating how the standardized Barber-Greene equipment can be adapted to the requirements of each particular case.

We will be glad to send you our AB catalog and cost reports.

Or, if the shortage and cost of shovel labor are a pressing problem for you, we will be glad to have one of our engineers call now, without any obligation on your part.

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Western Park Avenue Aurora, Illinois
Offices in 33 Cities

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Portable Belt Conveyors Self Feeding Bucket Loaders

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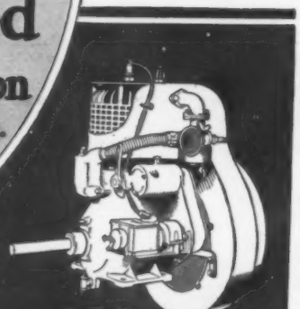
by your old conception of a gasoline engine. Consider only



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Please send catalog and bulletins giving complete information about SIGNAL Radio equipment to name and address written in margin.

Civil Engineering Notes

The Great Lake Hydroelectric Project in Tasmania is now completed, having a maximum capacity of 63,000 horsepower. Of this, 54,000 has been already contracted for.

Internal Combustion "Locomotives."—A terminology rather foreign to American usage is found in some equipment now being installed upon docks in the Gold Coast, and described in *The Engineer* for December 15. Though these engines are actually internal combustion affairs, the term "locomotive" is used in their description and they resemble strongly in appearance a dwarf steam locomotive. They are in every sense automobiles on the railroad track.

Tube-Making in the Movies.—At an informal meeting of the British Institution of Mechanical Engineers in December, a film was exhibited showing the manufacture of solid-drawn steel tubes. The film was introduced with a brief outline of the several processes employed in piercing billets preparatory to their being drawn down to tubes. The film itself gave glimpses of most of the processes through which the tubes go, and was followed by lantern slides of pipe joints. Films of this character are fast making a place for themselves in industry, and it is particularly gratifying to see them so well received in conservative Britain.

Electricity from Brown Coal is the bold undertaking now being put through by the government of Victoria. The scheme provides for the erection of a generating station on the coalfield with an initial capacity of 50,000 kilowatts, but capable of doubling. The estimated cost is about $12,000,000, for the initial development, and over $25,000,000 for the final project. The first section will include four 12,500-kilowatt turbo-alternators running at 3000 r. p. m., with an 800-kilowatt set for starting up the bigger ones. The boilers and the steel for the buildings are actually under construction, and preliminary steps are being taken for the erection of the high-tension transmission line of 112 miles to a point near Melbourne. This line is to operate at 132,000 volts, and will consist of aluminum-steel reinforced cable strung on galvanized towers 1000 feet apart.

French Road Reconstruction.—Although since the war attempts have been made to repair the damage caused to the main roads by the transport of artillery and the frequent passage of heavy lorries, nevertheless, much remains to be done in order to fit the main roads of France for modern traffic. This fact has been acknowledged by the Chamber of Deputies, which has now passed a bill by which large numbers of main roads are to be relaid. The bill applies both to departmental and national roadways, and provides for the relaying, with all modern improvements, of 7500 kilometers of national roadways and a similar distance of departmental roads. A State subsidy will be granted to the departmental authorities for the latter category. Not only the industrial importance of a route, but also its interest from the tourist's point of view have been studied in making a selection of the roadways to be relaid.

French Hydroelectric Power.—Addressing the Société Scientifique de l'Isère, M. Duerest remarked that the remedies for seasonal and daily fluctuations in water-power undertakings were, on the one hand, the improvement and extension of the big distribution networks, and, on the other hand, the erection of great complementary generating stations, whose effect would be the regulation of production and the obviation of insufficient seasonal and yearly supplies. Such generating stations should be hydraulic, on account of lower cost, and the reservoirs supplying them should be of moderate size, but situated at great heights, or of larger size if situated at lower altitudes. The Alpine regions were specially suited for such reservoirs, owing to the torrents from the upper glacial districts. Passing in review a number of reservoir schemes under way in the neighborhood of Grenoble, the lecturer indicated the many lakes in the Belledonne range which must eventually be harnessed. Two other big schemes lately projected were the Chambon Dam on the Romanche and the development of the Laffrey Lakes. But while the Chambon Dam would benefit existing stations on the Romanche only, the Laffrey scheme would favor the construction of a complementary station, meeting, not only the needs of existing consumers, but also future demands. The lecturer advised the appointment of a committee to study questions of such importance.

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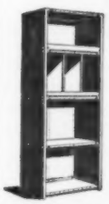

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Mechanical Engineering Notes

The Conveyor Belt has been found able to beat the cheap labor of India at jobs of large bulk such as the unloading or loading of large quantities of sand and brick between car and ship, car and storage, etc.

Machine Bearings have apparently been reduced to their simplest terms by a German inventor, who uses pieces of limestone embedded in an ordinary white metal bush. On tramcars in the Hamburg section, these bearings have shown a life of 35,000-45,000 miles, against 6000-7000 for ordinary white-metal bearings.

The Increase in the Fatigue Factor due to the presence of an excessive number of rivet holes in a given section of metal is not so high as it had been supposed to be, according to a recent British investigation. This, it will be understood, is quite aside from any direct weakening of the tensile strength of the piece, and refers, as the title of the research indicates, only to the fatigue effect.

What Are Wearing Qualities?—The wearing strength of a metal is in part a function of toughness, and in part of hardness. A British contemporary suggests very pertinently that even as regards hardness tests alone we are on no certain ground, and that as regards wearing qualities in toto there is at present no single satisfactory test. A more or less conventional way of expressing wearing strength by means of a single numerical index would indeed be a thing of much convenience.

The Last Word.—That this is probably just as far ahead of us as it ever was is the thought which we take away from a recent advertisement. Machine design has been moving so fast, for so many years, that one might be pardoned for supposing that fundamental principles must by now have been pretty well settled. Yet a prominent tap manufacturer is able to announce a radically different tap contour that is so new as to have the patents still pending, and which he regards as a development of prime importance. The claim is made that with this tap, drilling speed is tapping speed.

Sand Blast for Cleaning Boiler Tubes is the latest thing in this important field. Put out by a concern at Durlach, Germany, the apparatus consists of a length of pipe with a special nozzle, hitched to a compressed-air line, and a supply of sand. The sand is claimed to cut away scale and to polish the tube surfaces without damage of any kind, and may be employed wherever the pipe can be introduced. The air pressure is from 15 to 30 pounds, and the consumption about 4000 cubic centimeters of free air per minute. In 60 seconds the blast is said to clear away 40 to 60 square feet of scale, while with soot, of course, a far better performance is scored.

Proper Rake Adjustment.—*The Practical Engineer* quotes some worth-while remarks on this subject which it attributes to one O. Linley. When taking heavy cuts which naturally produce a strong chip, much of the power is absorbed by forcing this past the top of the tool. The more acute this angle, the less the chip has to be bent and driven, and the less power thus wasted. In carbon steel, this "top-rake" angle cannot be too acute, owing to the weakness of the metal; but with high-speed steel, the great strength allows a more acute angle of top-rake. Accordingly, it is now possible, and accepted practice, where much metal is to be removed, to use a deep cut and fine feed rather than the reverse.

An Expanding Pulley.—A new British expanding pulley differs considerably from the ordinary pulley type. Segments are fitted between two circular plates with radial slots, adjustment being made by a striking gear, which opens or closes the segments as required by sliding them in the slots. In this way a variation of 60 per cent can be made in the speed—employing one pulley to drive a similar one. The actual expansion is effected by a thrust plate (provided with a ball thrust) which operates internal cones; these slide along the boss or barrel and operate on a tapered surface on the underside of the segments. When each set of segments reaches its least diameter a turning movement occurs, with the result that as expansion takes place, the edges cannot cut the belt, as the radius of each segment is less than that of the pulley as a whole. Centrifugal action is overcome by means of specially-designed springs, housed in a malleable cast-iron flange ring and enclosed by an aluminum guard. The gear can be arranged for automatic operation.

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Miscellaneous Notes

California's Fruit and Vegetable Pack.—The annual output of the fruit and vegetable canneries of California amounts to 17,000 carloads, or enough to fill a train 135 miles long.

Honey That Will Not Be Gathered.—Bees have preempted the top of the Henry Clay statue in the cemetery at Lexington, Ky. This statue was struck by lightning a few years ago and the head dislodged, and a new head was fashioned by a sculptor, and it is in it that the bees have their hive.

Who Licked Stamps First?—A claim is put forward for one James Chalmers of Arbroath, Scotland, who submitted specimens of adhesive postage stamps to a committee of the House of Commons in 1834. Rowland Hill is also credited with the invention, having experimented with adhesives in 1837. As Rowland Hill directed the British postal arrangements for many years he was probably the first man to lick a stamp.

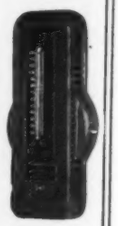
Automobile Foot.—"Housemaid's knee" has dropped out and we have something else to take its place. This is what is known as "Automobile Foot," which is selective, aristocratic and harmless. This is caused by the slight cramp from holding the foot on the accelerator for long periods. It is not probable that many will seek medical assistance from this new ailment. It must not be supposed that automobile foot, or chauffeur's foot as it is also called, has the sole distinction even at present, for there are other vocational foot disorders, such as "policeman's heel," "dancer's foot," "golfer's foot," and others.

Jenny Lind as an Inventor.—We scan the records of the Patent Office in vain to find the name of Jenny Lind as an inventor. Yet she was responsible in a large degree for the "parlor car." When she was brought to this country by P. T. Barnum she was obliged to spend much of her time in traveling from place to place on the wretched railroads of the period. So, to reduce the discomforts of the trip, she had the seats of an ordinary car removed and the vehicle furnished with chairs, tables and other pieces of furniture which would be appropriate to a parlor. She jocosely called this her "parlor car," and it is undoubtedly from this that we get the name for our Pullman chair cars.

Discovery of a New Valley.—The discoveries of new territory are comparatively few in the United States, owing to the great activity of the Geological Survey, as well as explorers and mountain climbers. There seems, however, to be an unconquered valley in Siskiyou County, California. "Hidden Valley," G. W. Pellepreau, the discoverer of the valley, said he had glimpsed it from a mountain peak with the aid of high-powered binoculars. From all reports he believed the valley had never been entered. Some men believe it abounds in game and that mineral deposits are likely to be found. Walls of sharp peaks surround the valley, standing like a barricade against man's advance. Once over the walls, Pellepreau predicts, scaling ropes and ladders will be necessary to get beyond the chasms. He estimates the valley contains 300 acres.

Color for Hospital Walls.—The modern hospital has been made about as sanitary, cheerless and uncomfortable looking as it is possible to make it with the aid of white calcimined ceilings, enameled walls, and white enameled iron furniture. In the new Fifth Avenue Hospital all this is changed. The walls are delicately tinted in French gray, buff or tan, and the furniture is what we would find in a modern hotel. A great deal of the horror of a hospital is brought about by the idea of being wheeled into an immense operating room, with nothing but operating tables, knives and saws, which are not calculated to distract attention from their own ills, and the patient usually remains in terror until the anaesthetic has done its work; but at the Fifth Avenue Hospital the patient is taken into an anaesthetizing room which resembles a small parlor. It is attractively furnished and even has a rug on the floor, and there are curtains at the windows. This new hospital has many interesting devices; for example, suites of offices are provided for physicians at the hospital, so that they can see their private patients just the same as they would in their own office, thus being able to keep in touch with the other patients in the hospital. This office enables the physicians to take advantage of the diagnostic facilities of the hospital for their private patients.

What of the Man ?



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Seventy-Eighth Annual Statement

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This is a great property. Your policy represents your share in that property; your policy IS PROPERTY. Do you own a piece of Real Estate? Your Real Estate is not so certain in its value as your Policy in this Company. Do you own a Bond? The best Bond is no more certain than your Policy, and lacks its EMERGENCY POWER.

You bought your bit of Real Estate, your Bond and your Life Policy for the same purpose—to protect your dependents, to protect yourself, in old age. Your Life Insurance Policy is as certain as your Bond, more dependable than your Real Estate. This property is being distributed almost as fast as it accumulates under an increasing business. In 1922 we paid you (policy-holders and beneficiaries) $130,143,274.58.

DARWIN P. KINGSLEY,
President.

Balance Sheet, January 1, 1923

Bonds at Market Value, as Determined by Insurance Department, State of New York

ASSETS		LIABILITIES	
Real Estate owned	$ 8,238,684.28	Policy Reserve	$788,236,317.00
First Mortgage Loans—		Other Policy Liabilities	22,747,657.36
On Farms	57,592,277.53	Dividends left with Company to Accumulate at Interest	10,492,741.71
On Residential and Business Properties	143,070,999.93	Premiums, Interest and Rentals prepaid	3,508,893.64
Loans on Policies	166,099,516.84	Taxes, Salaries, Accounts, etc., due or accrued	7,452,155.33
Bonds of the United States	115,370,340.00	Additional Reserves	7,946,366.00
Railroad Bonds	285,079,312.14	Dividends payable in 1923	48,769,410.67
Bonds of other Governments, of States and Municipalities	152,583,974.81	Reserve for Deferred Dividends	39,310,473.00
Cash	8,816,310.47	General Contingency Funds not included above	60,088,196.25
Other Assets	51,700,794.96		
Total	**$988,552,210.96**	**Total**	**$988,552,210.96**

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Where used?

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Dings High Intensity MAGNETIC SEPARATION

DINGS MAGNETIC SEPARATOR CO., 709 Smith Street, Milwaukee, Wisconsin

Radio Notes

Radio Amateurs in France.—According to the Under-Secretary for Posts and Telegraphs, more than 50,000 private radio installations are now in operation in France. This figure is in striking contrast with the few stations in existence but a few years past, when the French laws limited amateur radio to experimental and instructional institutions.

Radio Panels and Cabinets are at last becoming standardized so that a builder of radio apparatus can safely proceed with a given panel knowing all the while that a cabinet can be obtained at any time to take that panel. One of the leading manufacturers of panels has now adopted the commendable practice of wrapping his goods in neat packages, with the size plainly marked, and with simple but invaluable directions as to how to work and finish the panel. The panels are trimmed smooth and are packed in glassine to protect the surface so that the buyer receives them in perfect condition.

Exercises by Radio.—A novel feature has been introduced by the WHN radiophone station at Ridgewood, N. Y. This station has been broadcasting morning exercises as early as 7 a. m., for the benefit of early risers, in addition to its weather report and the latest overnight Washington, foreign, and domestic news. Another period of morning exercise is given at 7.30 a.m. At 8:00 a. m. still another period is provided for late risers. These exercises are given with music. At 9.15 a. m. the WHN station sends out a series of reducing exercises, intended especially for women, and at 10.30 p. m., bedtime exercises with music are given in connection with final night news and the evening program.

Transatlantic Radio Telephone Programs are becoming relatively common. Indeed, one of our eastern radio-phones now calls itself an "international radio-phone station," and adds "U. S. A." to the usual announcement of its location. The WOR radio-phone at Newark, N. J., was the first station to transmit across the Atlantic. Since then the WJZ and the WGY stations have been picked up in England and France. A Plymouth radio amateur during the latter part of December, succeeded in hearing the whole of the evening program broadcasted by the General Electric Company station WGY. A loud-speaker was used and six persons heard the concert plainly without using head-phones.

Radio Telephony for Transatlantic Service is well within the range of early realization. Several weeks ago the American Telephone and Telegraph Company conducted some interesting radio telephone tests between New York City and New Southgate, a London suburb. Although radio telephone words had been transmitted across the Atlantic before these tests, it remained for these recent tests to prove that entire conversations could be carried on with distinctness and full understanding. Mr. Thayer and Mr. Carty of the telephone company spoke from their offices in New York City, using the usual telephone instrument which was connected by a telephone circuit about 70 miles long, half of it being underground cable and half open wire, leading to the powerful radio telephone transmitter at the Rocky Point station of the Radio Corporation. The distance from the Rocky Point station to New Southgate is 3400 miles. For the transmission there were employed 20 of the new 10-kilowatt vacuum tubes arranged with modulators and filters to radiate about 100 kilowatts of radio energy.

Conference on Radio Standardization.—As these lines are being written we learn that the Bureau of Standards has called a conference on radio standardization to be held on January 12, 1923, in New York City. The call has been issued at the request of the Institute of Radio Engineers, the National Radio Chamber of Commerce, the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies, the National Retail and Dry Goods Association, the American Radio Relay League, and the Radio Corporation of America. Invitations are being issued to all national associations of an engineering and technical nature known to be interested in radio standardization, and radio manufacturers will be represented through the trade associations of which they are members. The purpose of the conference is to consider broadly (1) whether a formulation of standards for radio apparatus and service shall be made; (2) if so, what general classes of apparatus or ser-

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Classified Advertisements — Continued

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MISCELLANEOUS

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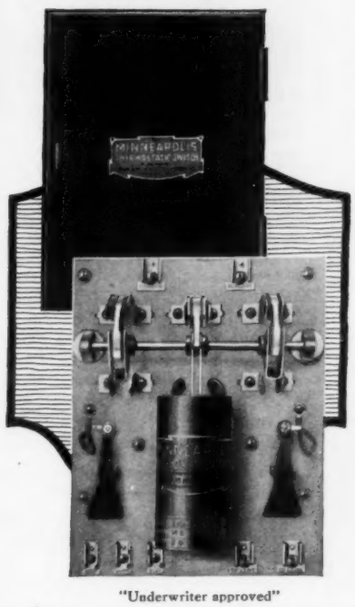
vice shall be included, and (3) what procedure shall be recommended for carrying out the conclusions reached by the conference. It is expected that any radio standards formulated will be so prepared that they may ultimately be adopted with the approval of the American Engineering Standards Committee.

The Reflex Circuit is the latest arrangement to attract the attention of radio amateurs, following close on the heels of the Armstrong super-regenerative circuit. The reflex circuit is an ingenious device for using vacuum tubes twice over: that is to say, a given radio signal is passed through a certain number of tubes acting as radio frequency amplifier tubes, then rectified by means of a crystal detector, as a general rule, and then passed back or "reflexed" to the same tubes as were first used, but this time serving as audio frequency amplifying tubes. Thus three tubes may be employed to do the work of six tubes. The use of a crystal detector for rectifying the radio signals is said materially to simplify the arrangement of the reflex circuit. One of the leading radio manufacturers has placed a reflex receiving set on the market, which makes use of a small two-foot loop antenna. Resting on any library table with its small loop mounted on top of the cabinet, this reflex receiver will receive broadcasting stations on a loud-speaker up to 100 miles, and, when using head-phones, it will receive stations up to 1000 miles. By using an outside antenna greater distances can be spanned.

Expiration of the Fleming Valve Patent.—On November 7 last, the Fleming valve patent, which has been the cause of radio litigation for many years, expired, and in the opinion of many persons in and out of radio, one of the serious hindrances to radio progress has been removed. The expiration of this important British patent gives to the American inventor of the three-electrode tube, Dr. Lee de Forest, the right to make free use of his own invention, heretofore denied to him. Shorn of all legal and technical terminology, Dr. Fleming had in his valve a mere rectifier of high frequency current, perhaps of less value in a commercial sense than even the crystal detector. It is conceded that the Fleming valve was never in any sense a good radio detector for practical purposes. The DeForest patents on the audion or three-element vacuum tube, number over twenty. Rights to manufacture the audion and to use it in long-distance telephone communication, as well as in the radio field, have been granted under the form of a lease to the Western Electric Company, which is the manufacturing agent of the American Telephone and Telegraph Company, and also through an exchange of patents to the General Electric Company, Westinghouse Electric and Manufacturing Company, and the Radio Corporation of America.

The Acoustical Problem in Broadcasting is being squarely faced in Great Britain, where radio is the hobby of the hour. In a recent issue of *The Electrician* of London a correspondent points out some of the present drawbacks to good broadcasting. Among other interesting observations, he points out that much of the present receiving equipment is designed primarily for ordinary radio telegraph work and not for radio telephony. The regenerative arrangement, for instance, is an excellent method of increasing the sensitivity of a receiving set by feeding back part of the output into the input of a vacuum tube, but while doing so it unfortunately changes its sensitivity with frequency so that fine articulation is somewhat impaired. It would often be advisable to limit reception to nearby stations and to do away with the regenerative feature, so it would seem. Again the design of transformers play a fundamental part because unless these are so designed that their ratio of transformation at audio-frequencies is nearly constant over wide ranges, distortion results. Receivers, too, whether of the small head type or of the loud-speaking type, are liable to introduce distortion. For example, it is a common fact that the diaphragms of ordinary small receivers have a tendency to resonate around 800. It follows, therefore, that every time a singer or a musical instrument emits a note somewhere near this frequency, distortion occurs. This is even more apparent in loud-speakers. The horns, too, are highly important so far as their acoustical properties are concerned. Meanwhile the acoustical problems of the studios have been studied so that the remaining sources of distortion are rather at the receiving end than at the transmitting.

The Dependable
MINNEAPOLIS THERMOSTATIC
Relay Switch



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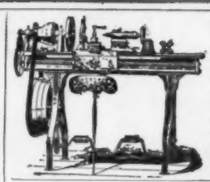

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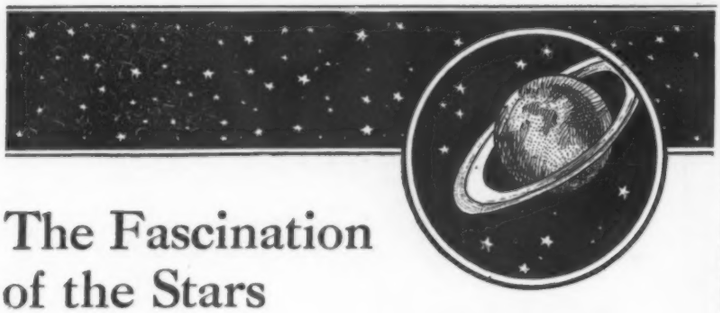

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THE DAYTON STEEL FOUNDRY CO.
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Where Do Elephants Die?

(*Continued from page 207*)

fact that many attempts have been made to solve the problem. The districts where elephants occur in a wild state have been scoured in all directions in the hope of discovering the last resting place of the huge animals, but without any result. Quite recently another determined attempt has been made to penetrate the mystery, but, up to the present, nothing of any value has been discovered. As a matter of fact the problem has more than a scientific interest to it. Any individual who is so fortunate as to find the elephants' graveyard will certainly have made a fortune. On this spot there must be a huge accumulation of ivory, a commodity which is continually increasing in value.

Our Psychic Investigation

(*Continued from page 160*)

Another problem that is interesting enough to mention on the mere ground of the difficulties which it presents is that of photography under conditions where the flashing of a bright light would not be tolerated. The layman's suggestion here, of course, is to use ultraviolet light, which most of us know to have high photographic value. Unfortunately, these short-wave radiations are not a thing apart, and no source for them is known which does not at the same time give off visible wave-lengths in considerable magnitude. Moreover, since it is the short-length light that disturbs the medium, and the longer waves from the red end of the spectrum that are tolerated by her, we should have no guarantee until we have tried it that the ultraviolet would not disturb the psychic balance even more seriously than visible white light.

A rather large class of psychic phenomena are those that appeal to the sense of sound. Doubtless some of our readers were mildly shocked to learn that we did not contemplate the exclusion of these. As a matter of fact, the human race needs badly to be reminded that the eye is not its only sense organ. We are altogether too much in the habit of assuming that the verdicts of all other senses must stand or fall upon their checking by eye. This, in our opinion, is a grave mistake. The sound wave and the electric current are real phenomena, regardless of what the eye may tell us about them. And surely the person who insists that everything must be seen to be believed, will admit that the air is a material substance? So before deploring our willingness to admit things that cannot be seen, but can be recorded through other vehicles than that of vision, we hope every reader will examine more critically the grounds for his dependence upon this one avenue of contact with the external world.

Our departure from this exclusive dependence upon one means of perception brings with it the necessity for recording sound waves with the same precision as that to which we are accustomed in the recording of light waves. The answer, of course, is easy—the phonograph for occurrence and character of sounds, the directional microphone for their source. Incidentally, we cannot conveniently use up miles and miles of wax in keeping our phonographs running for the reception of any sounds that *may* occur; so we shall have to have some sort of cut-in and cut-out for the phonograph motors. We are not yet certain whether this will be automatic, and actuated by the occurrence of the sounds that are to be recorded; or whether one of the experimenters will have a switch which he will be charged with closing whenever sound-wave phenomena are occurring.

Another comparatively recent scientific development is one that most of us first met in the pages of the Craig Kennedy detective stories. The kymograph, the sphygmomanometer and other devices for recording the respiration, the heart-rate, the blood pressure, and the other psychological functions of a human being are not the creatures of Mr. Reeves' imagination. They exist, and we shall use them at our seance. Independent experiments are right now being made in New York seeking to determine the extent of their utility in the seance room. Just what fluctuations in the mediums physical processes will they show at the moment when phenomena occur, and just what will be the significance of this? We hope to take advantage of what others may find out here, and to make our own contribution. An interesting suggestion, and one which we shall put into effect at times, is that the emotions of the sitters should be clocked off by these instruments.

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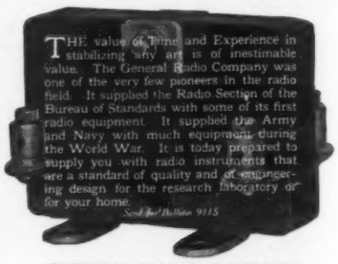

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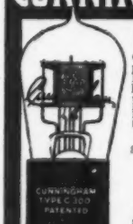

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Write for descriptive matter.

J. A. RITTER, Lansdowne, Pa.

Nicotine in Your Tobacco and Tobacco Smoke

(Continued from page 164)

nicotine in the tobacco smoke. Tobacco, in the three forms in which it is commonly used—the cigarette, the cigar and in the pipe, burns under altogether different conditions. The result is that the smoke contains varying amounts of nicotine. In the case where the tobacco burns most completely, the nicotine content of the smoke will be least. Furthermore, the amount of tobacco, still unburnt, which the smoke has to traverse before it reaches the mouth, is also a factor; for in its passage through the cigarette, cigar or bowl of the pipe, the smoke has a chance of absorbing nicotine from the unburnt tobacco.

The cigarette contains the least amount of tobacco and burns with the hottest flame. The red glow at the end of the cigarette produces almost complete combustion of the tobacco. The combustion in the case of the cigar is not as complete as that in the cigarette, but more complete than that in the pipe. Furthermore the smoke has less distance to travel through unburnt tobacco in the cigarette than it has in either the cigar or the pipe.

When Electricity Magnifies the Speaker's Voice

(Continued from page 167)

trodynamic receiver, and whatever subsequent improvements were made were in the nature of mechanical modifications, rather than on the electrical characteristics of the apparatus.

The electrodynamic receiver avoids all the weaknesses of the ordinary receiver, catalogued above. For one thing, the diaphragm is in no way directly concerned with the magnetic flux. There are no pole pieces to interfere with motion, which may be as great as the elastic limit of the diaphragm. A large horn attached immediately above the diaphragm provides the air column for the diaphragm to move. In the present instrument the field is magnetized to a point approximately 20,000 lines per square centimeter with a current of .66 amperes flowing in the field coil. The movable coil, with a resistance of 20 ohms, will take care of approximately 10 watts of modulated current as supplied by an amplifier through the proper step-down coil and will give off sound accordingly. When it is remembered that only an extremely small fraction of a watt is necessary to produce an audible signal, some idea may be realized of the volume of sound generated by this instrument, produced by the flow of ten watts. It must be remembered also that due to the electrodynamic principle involved, all of the incoming energy is transferred into air vibrations, and that the instrument is not only capable of producing loud responses to large inputs, but also is superior for clear articulate response to very small currents and is fully as sensitive if not slightly more so in this respect than the best design of electromagnetic receivers.

Commercial development of this type of receiver proceeded along several interesting and different lines. For receiving telephone speech alone, without loud-speaking characteristics, with a 70-ohm coil, a receiver was built, using permanent magnets to be used on ships and in marine stations where communication was difficult. This type of electrodynamic telephone, using a double ear tube arrangement from the diaphragm, has become standard equipment of United States Navy destroyers for marine telephone communication and is being used on hundreds of merchant vessels for the same purpose, in conjunction with the anti-noise transmitter. The receiver can easily be made water-tight and its clearness of reproduction makes it indispensable for talking to the noisy engine room of any vessel.

A phonograph attachment was developed and placed on the market in 1916 and consisted of an electrodynamic receiver of the loud-speaking type, and its horn, a control box containing the proper induction coil and switches to control the current of the device, and a transmitter tone arm. Many and varied were the experiments necessary to determine the proper location of the transmitter on the phonograph tone arm in order that needle scratch be eliminated, and yet perfect reproduction of the music be maintained. This equipment was also supplied with a hand transmitter in order that speech might be amplified by the same instrument. The voice and music from a phonograph can thereby be amplified enormously for outdoor use.

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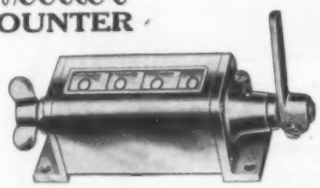
Veeder COUNTER

The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.



The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations, or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00 (subject to discount).

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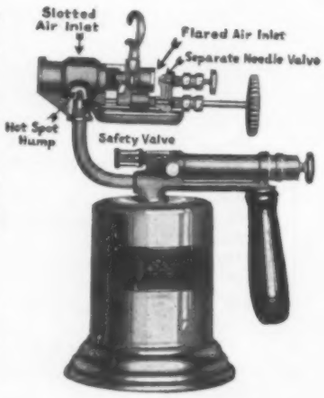

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Cedar Street

New Method of Salvage by Compressed Air

(*Continued from page 181*)

then attached and tugs take the boat in tow and place it in dock.

There are several outstanding features of the Reno system which place it in a class by itself. The depth at which it can operate is limited only by the strength of construction of the submarine chamber. The present machine has been built to withstand depths of 400 feet or nearly 300 feet deeper than divers can work. The drilling of the holes, the hauling down of the pontoons and the insertion of the hooks are not affected by the depth of water. The absence of light at great depths is overcome by the searchlights on the tractor. The tractor is guaranteed great freedom of movement on the bottom, on account of the fact that the greater part of the sea bottom is composed of fine sand, gravel or broken shells; while the average change of depth in the North Atlantic is on a grade of 1 in 124.

The time consumed in performing the operations is short when compared to the ordinary salvage operations which depend on the use of the divers. The drilling of holes is rapid; insertion of the hooks is a simple operation and the filling of the pontoons with air depends only on the capacity of the compressors used. Delays might be caused by storms which would make it dangerous to lower and raise the tractor. To overcome this, the mother ship to be used in future operations will be provided with a well, so that the tractor can be raised and lowered through the bottom of the ship and thereby avoid the objection of the weight of the tractor being swung out over the side of the ship at the end of a boom. Storms and surface disturbances will have no effect on the equipment after it is attached. There is no serious movement of water due to even the most severe storms below a depth of about 50 feet; so that should a storm drive the mother ship to port or cause a delay in the work after part of the pontoons have been attached, that part of the equipment already placed may safely be left until conditions improve.

When We Paint Our House

(*Continued from page 184*)

It has been mentioned that linseed oil dries, when exposed to air, and forms a solid film, which holds together the pigment and makes an impervious coating. Ordinary linseed oil dries very slowly, and accordingly it is boiled first with litharge or other suitable substances to dry it partly. Boiled linseed oil will dry much more rapidly than the raw oil. The importance of the paint coating drying within the shortest possible time is evident, and to further reduce the time required for drying, there are incorporated with the paint the pigments known as driers. These are materials, made in the plants, by mixing lead and manganese compounds with molten resin. Resinates are formed. These substances possess the property of accelerating the drying of the paint. They absorb oxygen from the air and give it up to the oil.

The Filler

Very often fillers are added to paints in addition to the pigments. These fillers are really dilutents of the pigments, and when they are added in too large quantities they may be classed as adulterants. A paint which contains too much filler is not a good paint. It will be found that such a paint will not cover the surface well and also it will not hide the color underneath. Barytes or barium sulfate is used largely as a filler. It possesses one advantageous property and that is that it lessens the amount of oil or vehicle that is required to make the pigment into a paste. It must be remembered that any solid has the property of absorbing liquids in varying degrees, and that each pigment is characteristic in its power to absorb linseed oil. It is clear that the more oil is absorbed by the pigment, the more costly the paint. Barytes being least able to absorb linseed oil is often added to pigments just because of that advantageous property. Other fillers commonly used are silica whiting, china clay, gypsum, etc.

While painting is the occupation of the painter, there is scarcely nobody who does not like to paint and does not know how to paint or at least does not think he knows how. It is perhaps because so many of us are painters in our spare time and like to do little odd jobs of painting ourselves instead of delegating them to the skilled workman that the mixed paint industry has assumed such large proportions.

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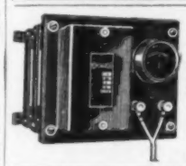

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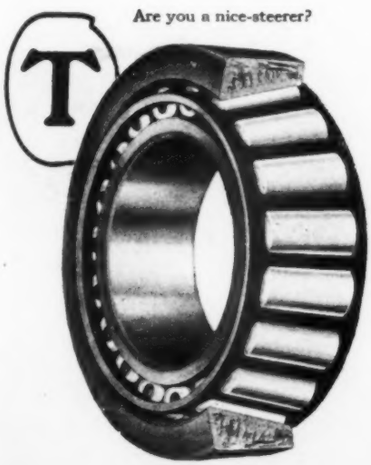

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